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design news

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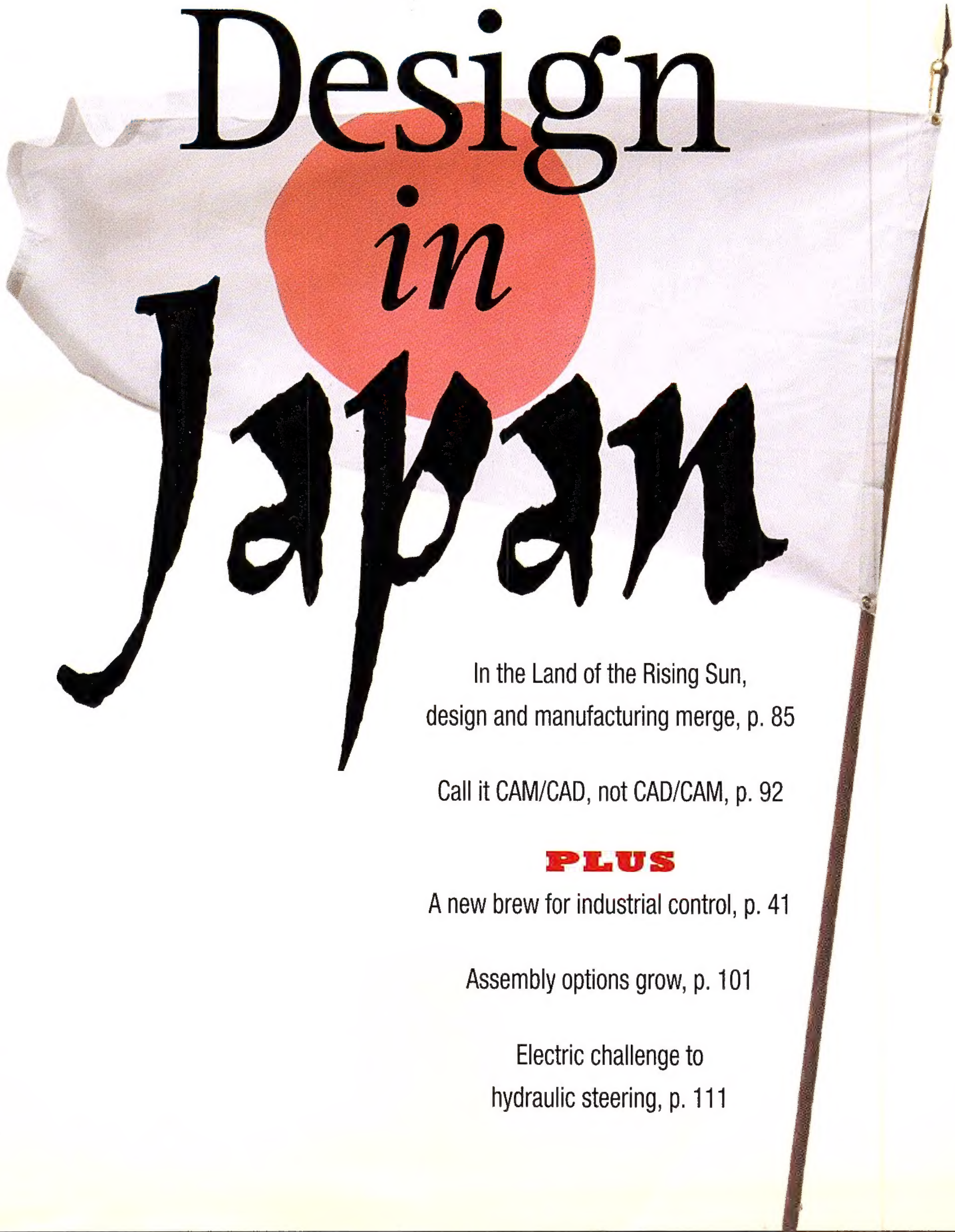


Design *in* Japan

In the Land of the Rising Sun,
design and manufacturing merge, p. 85

Call it CAM/CAD, not CAD/CAM, p. 92

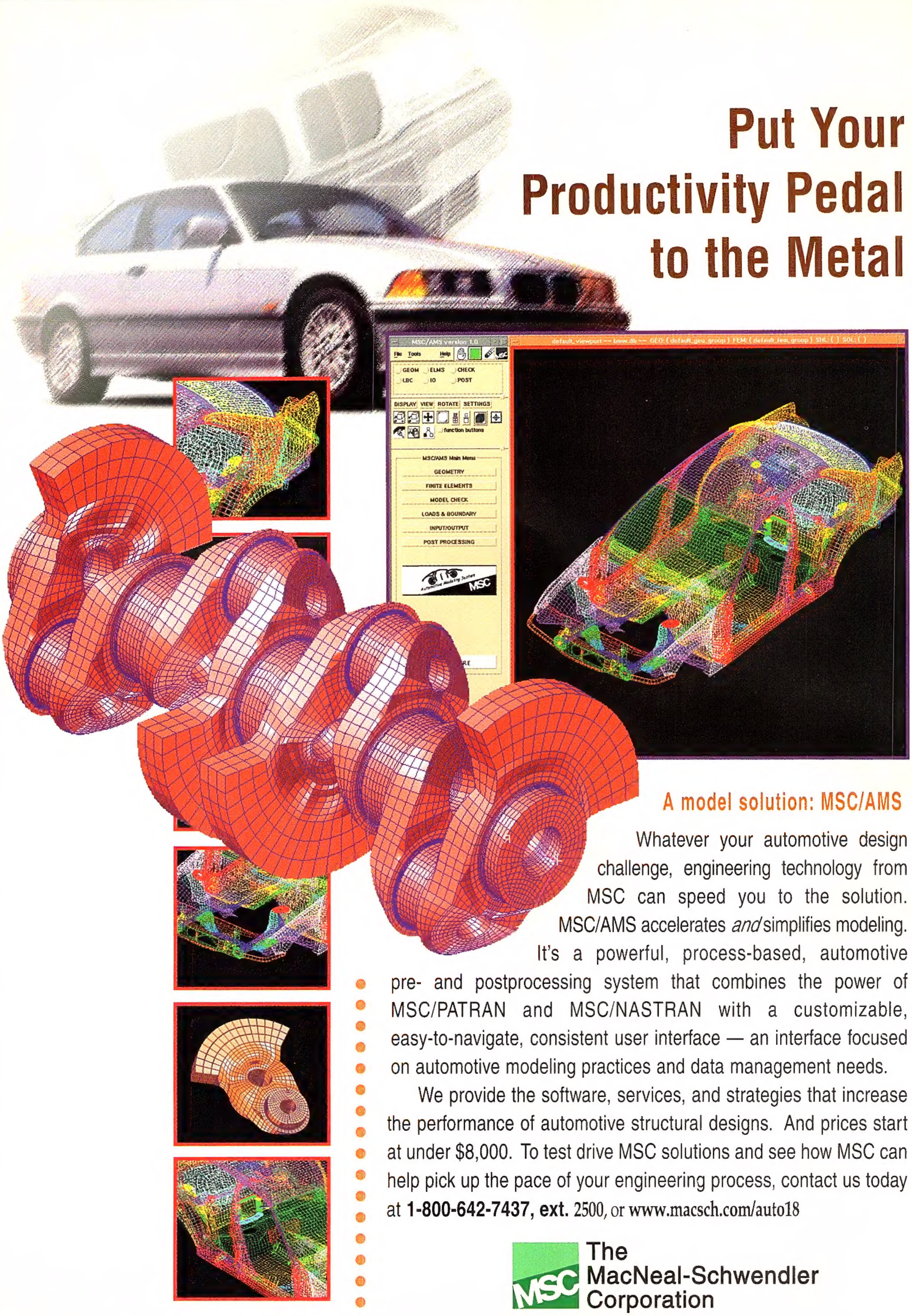
PLUS

A new brew for industrial control, p. 41

Assembly options grow, p. 101

Electric challenge to
hydraulic steering, p. 111

Put Your Productivity Pedal to the Metal



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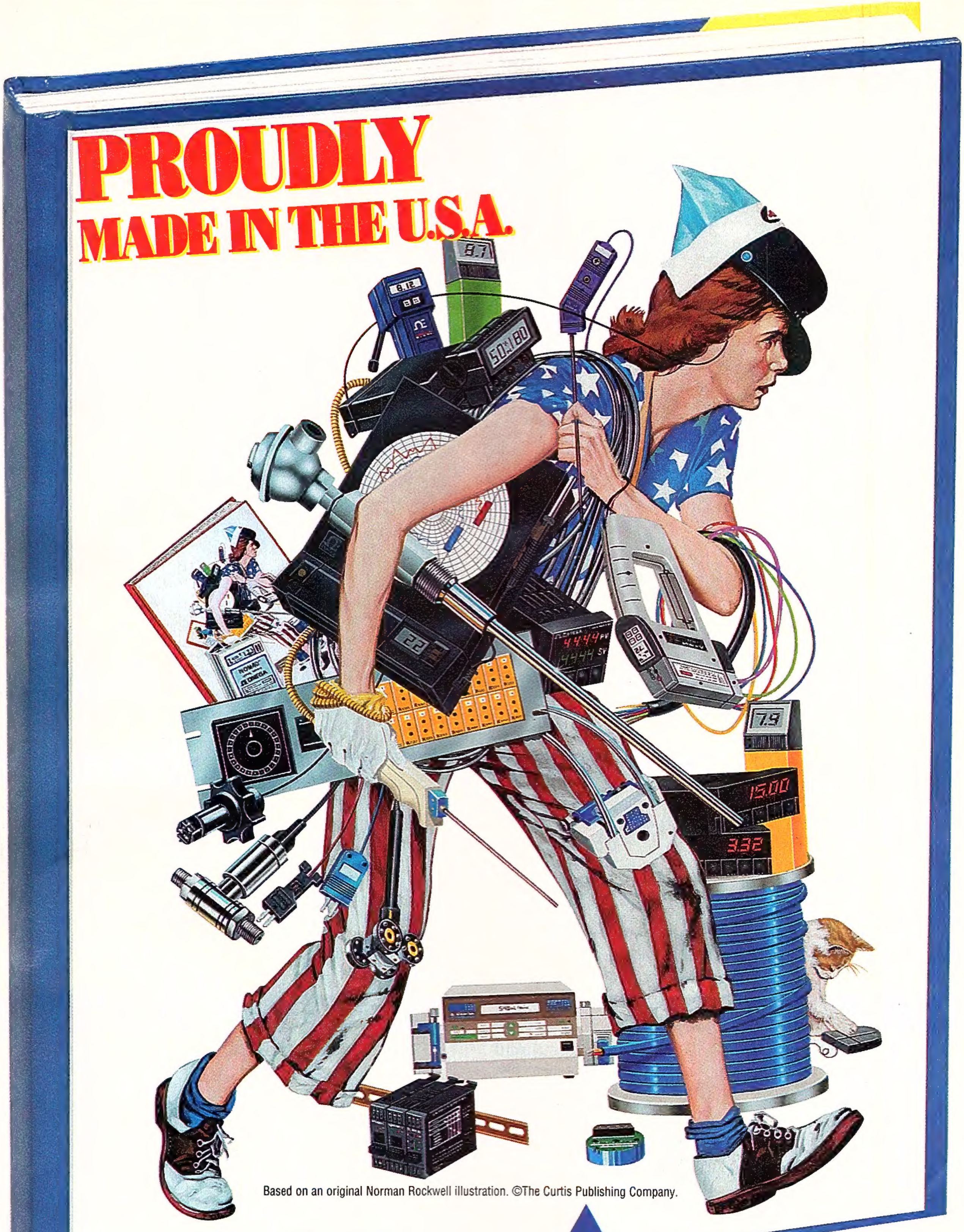

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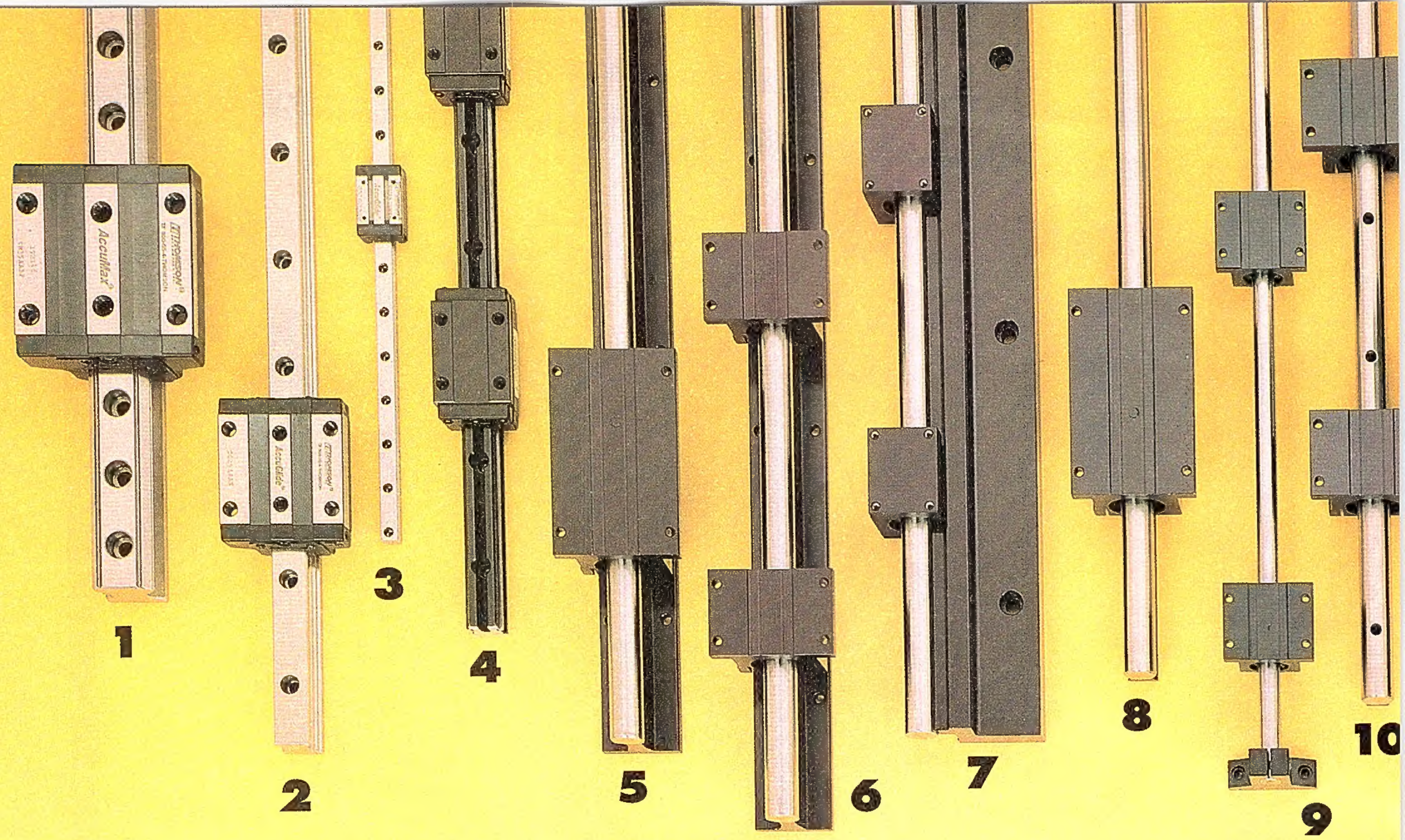

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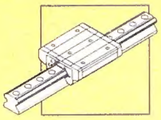
1 AccuMax*



High loads, extreme precision, high rigidity: Our patented Arcuate Advantage* eliminates roller skewing and edge loading, assuring smooth, accurate, predictable motion.

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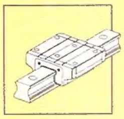
2 AccuGlide*



Industry standard envelope, interchangeable components: AccuGlide linear ball guides offer the only U.S. manufactured and supported alternative, with the advantage of component interchangeability in all accuracy classes and preloads.

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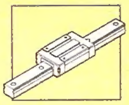
3 AccuGlide (Mini)



Ultra compact, high roll moment capacity: Patented AccuGlide miniature linear ball guides feature a superior ball control design for smooth, quiet, low-friction operation.

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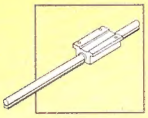
8 Bolt-From-Bottom



Enhanced sealing, low cost installation, highest loads, longest travel life: Well suited for harsh environments Super Smart Ball Bushing pillow block bearings offer 6X the load capacity or 216X the travel life of conventional linear bearings.

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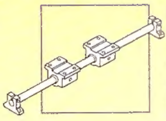
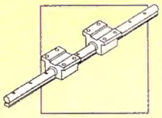
9 End Supported



Industry standard, longest travel life while spanning a gap: Super Smart Ball Bushing pillow block bearings on 60 Case* shafts for up to 6X shaft life or up to 216X the bearing life.

LinearFax No. 31621, 31721, 31821

10 Smart Rail*



Bolt-from-the-top, low cost installation, highest loads, longest travel life: Super Smart Ball Bushing bearings enable low cost installation from top down mounting, universal self-alignment, and the RoundRail advantage. Load capacities comparable to Profile Rail linear guides.

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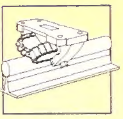
11 RoundWay*



Highest loads, contamination resistant, most rugged, fastest speed and acceleration: RoundWay* linear roller guides handle up to 35 tons/brg and speeds up to 100 ft/sec. It is insensitive to rail alignment errors.

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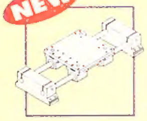
15 Double End Support

NEW



High roll moments, longest travel life while spanning a gap. Complete axis solution: Self-aligning for smooth motion under deflection. Pre-engineered, pre-assembled for low cost mounting.

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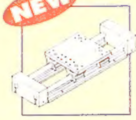
16 Double Continuous Support

NEW



Highest load capacity, longest travel life, rigid: Super Smart Ball Bushing pillow block bearings mounted to continuous shaft rail offer 6X the capacity or 216X the travel life of conventional linear bearings.

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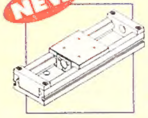
17 MicroStage*

NEW



Industry standard, most compact, extremely smooth, complete axis solution: Pre-engineered, pre-assembled for low cost mounting, lightweight design significantly reduces inertia..

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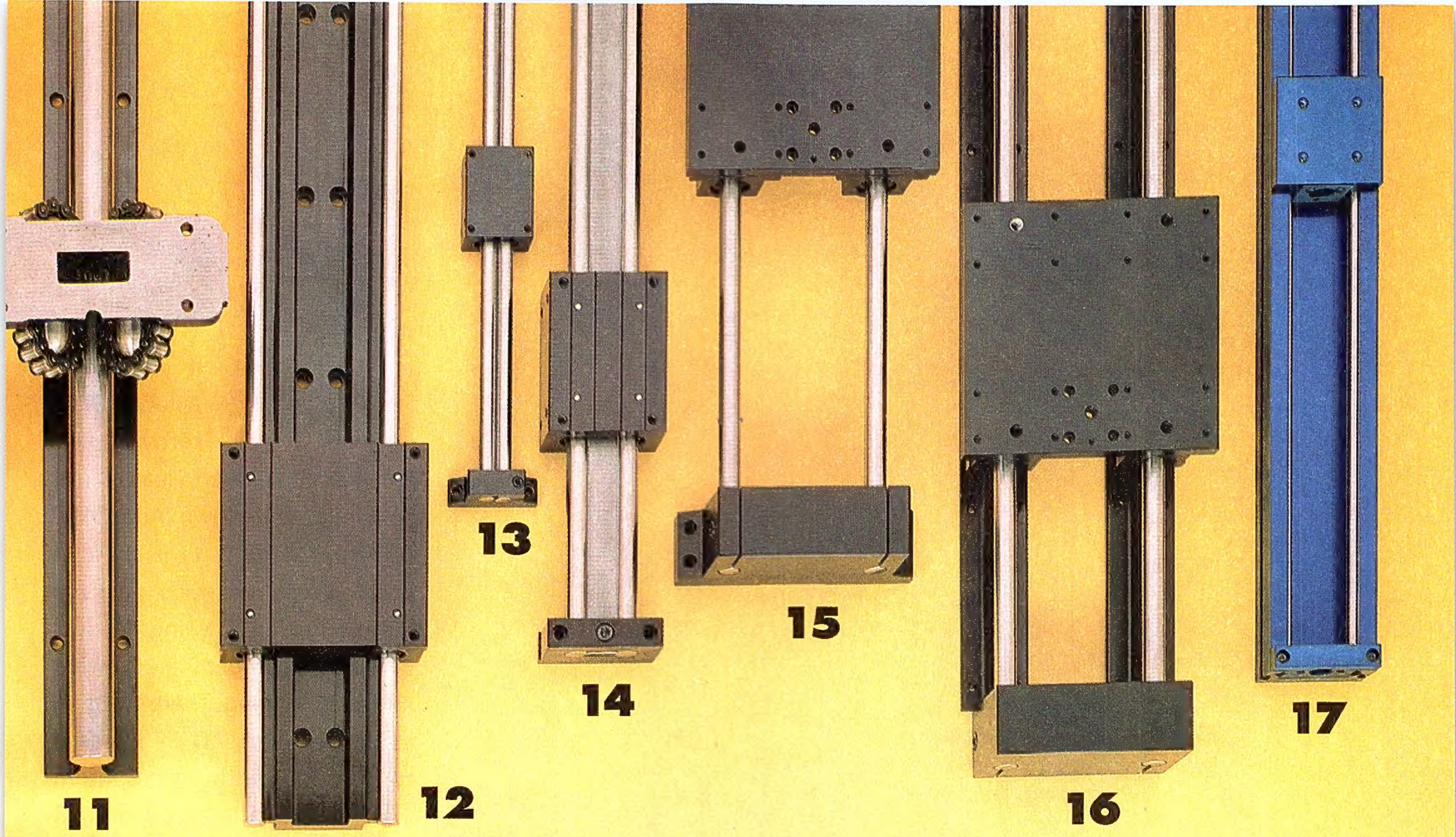

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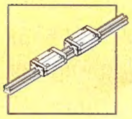
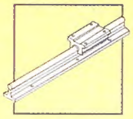
4 T-Series



Low cost, highest performance/cost ratio, industry standard envelope: Patented AccuGlide T-Series* linear ball guides offer lower purchase price and installation cost with the high load capacity of traditional ProfileRail linear guides.

LinearFax No. 38121

5 FluoroNyliner*



Corrosion resistant, industry standard, operates at temperatures up to 550°F: Patented self-lubricating polymer bearing linear guides are shock proof, smooth, quiet and insensitive to washdown conditions.

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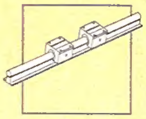
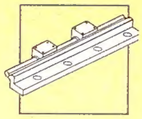
6 Continuous Support



Industry standard, highest loads, longest travel life: Super Smart Ball Bushing* pillow block bearings mounted to a continuous shaft rail assembly offer up to 6X the load capacity or 216X the travel life of conventional linear bearings.

LinearFax No. 37221, 81821

7 Side Mounted



Low profile, higher loads, longer travel life: Super Smart Ball Bushing pillow block bearings mounted to a continuous side mounted shaft rail assembly offer up to 6X the load capacity or 216X the travel life of conventional linear bearings.

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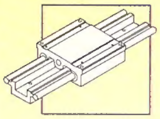
12 Dual Shaft Rail



High loads in all directions, long travel life, complete axis solution: Pre-engineered, pre-assembled for low cost mounting. Carriage complete with Super Smart Ball Bushing bearings mounted to dual shaft rail assembly for easy installation.

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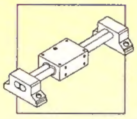
13 Twin Shaft*



Compact, resists roll moments while spanning a gap, ultra-smooth travel, complete axis solution: Patented Twin Shaft guide is pre-engineered, pre-assembled for low cost mounting. Self-aligning for smooth motion under deflection.

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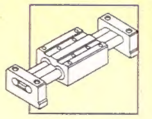
14 Twin Shaft Web



Resists high roll moments while spanning a gap, high rigidity, complete axis solution: Patented Twin Shaft Web guide is pre-engineered, pre-assembled for low cost mounting. Self-aligning for smooth motion under deflection.

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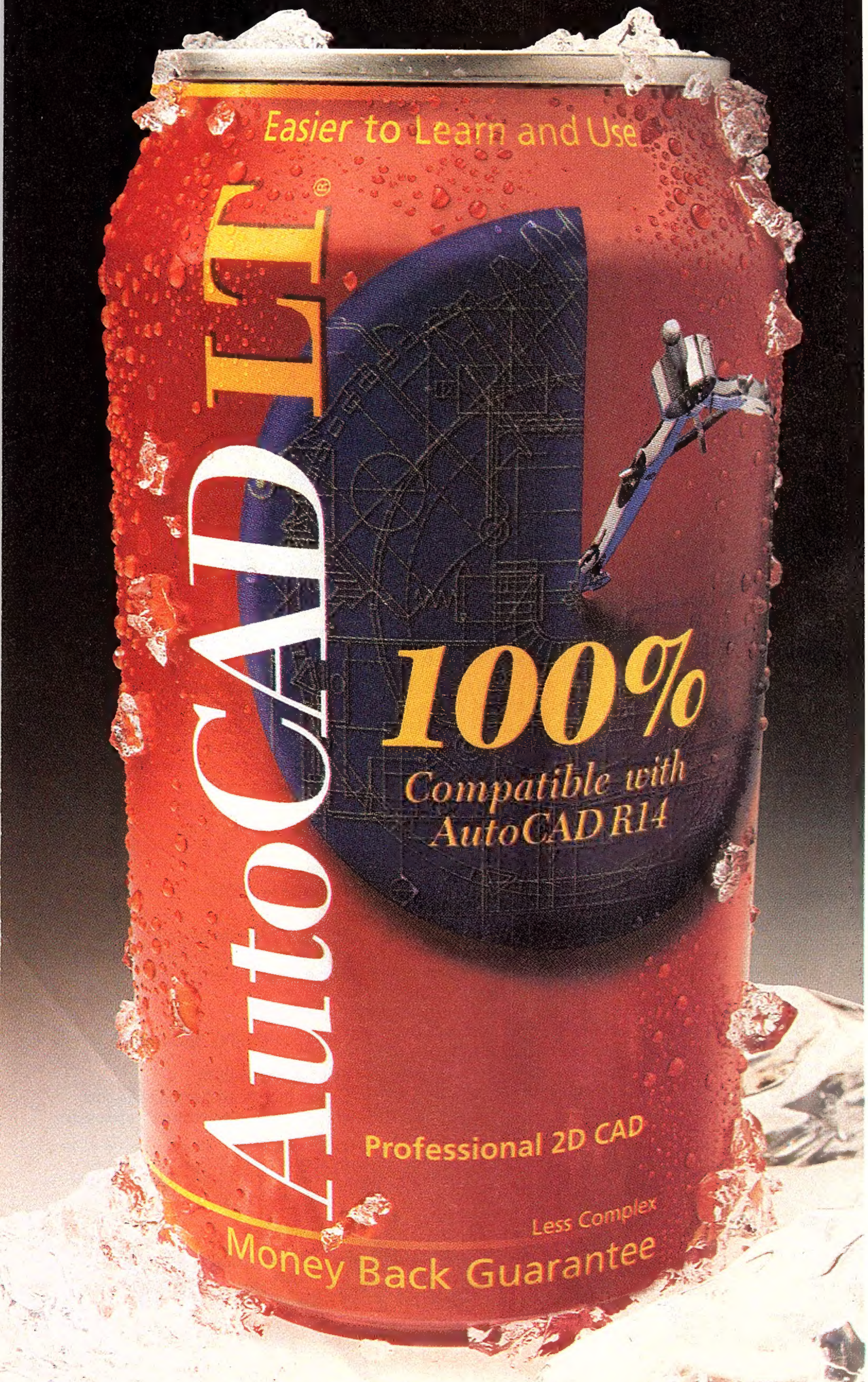

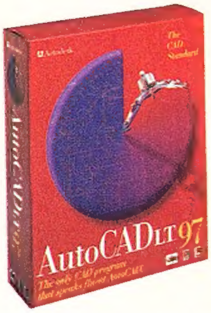

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design news

JULY 20, 1998 • VOLUME 53/NUMBER 14

AMERICAS BEST-READ DESIGN ENGINEERING MAGAZINE

features

The ultimate razor 78

The MACH 3 razor employs a design that borrows from its predecessors

By Christine M. Ferrara

Flared tube fitting stops hydraulic leakage 85

Maintains seal between beveled edge of fitting and flared tube

By Charles J. Murray

COVER STORY

Design in the land of the rising sun 86

In the U.S., engineers emphasize systems and use sophisticated software. In Japan, engineers concentrate on process and emphasize manufacturability. The two could learn a lot from each other.

By Paul E. Teague

In Japan it's CAM/CAD, not CAD/CAM 92

Designers don't have the detailing responsibilities common elsewhere

By Adele Hars, Contributing Editor

Assembly options grow 101

Lucky for you manufacturers of fastening and assembly products are focused on tackling your most challenging problems

By Deana Colucci

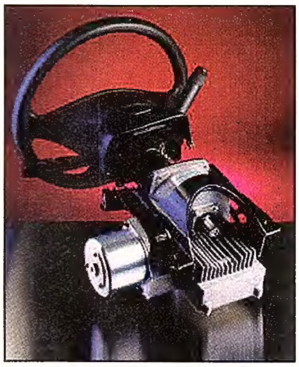
An electric challenge to hydraulic steering 111

Microelectronics and software make an old concept newly competitive

By Geoff Narin, Contributing Editor

*Design secrets from the land of the rising sun...*PAGE 86

*Japanese companies cut development time with CAD...*PAGE 92



*It's full speed ahead for electric power-assisted steering ...*PAGE 111

*Why this new razor is on the cutting edge...*PAGE 78

The Anatomy of Precision

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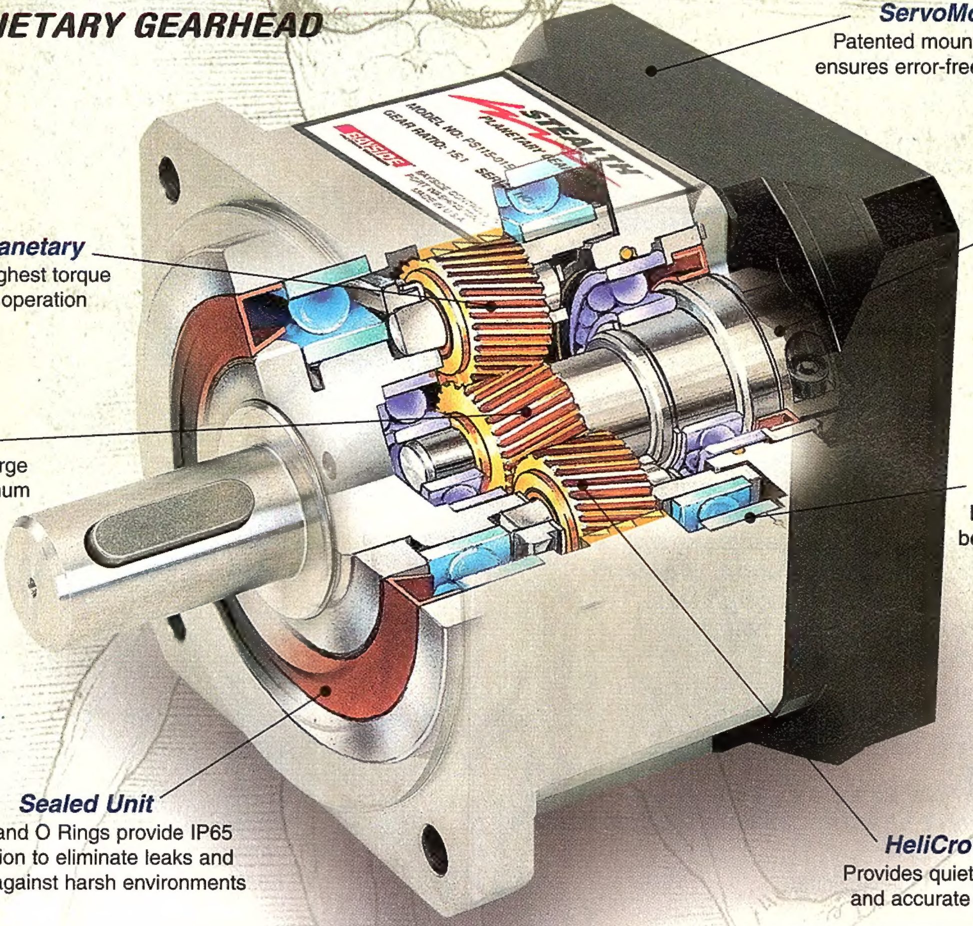

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Circle No. 154

design news

JULY 20, 1998 • VOLUME 53/NUMBER 14

WINNER OF MORE EDITORIAL AWARDS THAN ANY DESIGN PUBLICATION

news

41 A new brew for industrial control

42 Get ideas instantly

44 Analysis rides British racing circuit

44 American quiets older jets

46 Software expedites submersible design

46 Fuel cell targets consumer electronics

49 Running track designed for records

50 DSP board enhances instrument design

55 Appended trainer leverages defense dollars

58 Award sponsors support top engineers

61 Pressure reduction ups efficiency

63 Ford expands software use

65 Nylon coil survives lightning-like surges

77 Sneaker sensors keep marathon runners on track

departments

9 **Designer's Technology Index**

13 **Editorial**
Do you design for manufacturing?

13 **Editorial Staff**

16 **Instant Product Info!**

19 **Letters to the Editor**

27 **Technology Bulletin**

32 **Hot Products**

38 **Standards Update**

69 **Designer's Corner**
Extreme effecter, quick coupling, cool tool, and more

114 **Application Digest**

117 **Product News**

143 **New Literature**

166 **Guest Commentary**
New opportunities for MCAE

170 **Managing Design**
Develop your intellectual capital

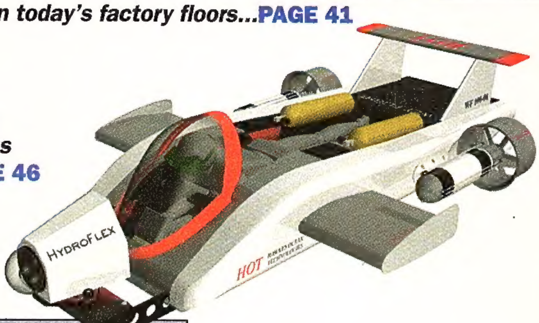
172 **Software Lab**
3D Studio VIZ R2

174 **Advertisers**

175 **Business Staff**

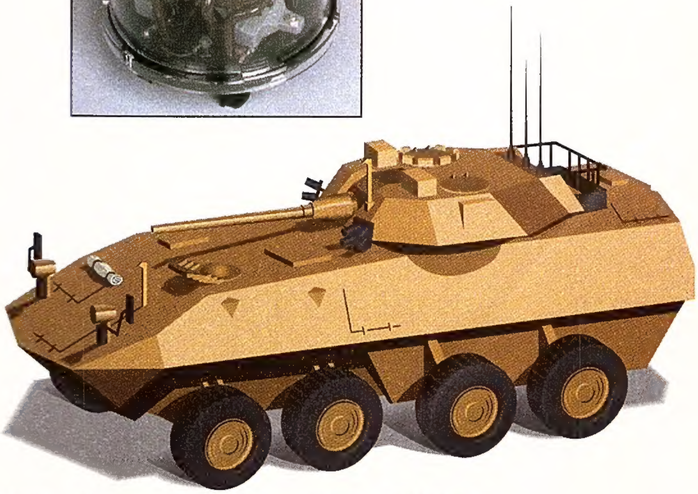
176 **Breaktime**
Laser zaps roadkill hazards

*Java percolates on today's factory floors...***PAGE 41**



*High performance submersible swims into action...***PAGE 46**

*Zap it, and this coil survives...***PAGE 65**



*Video trainer saves defense dollars...***PAGE 55**

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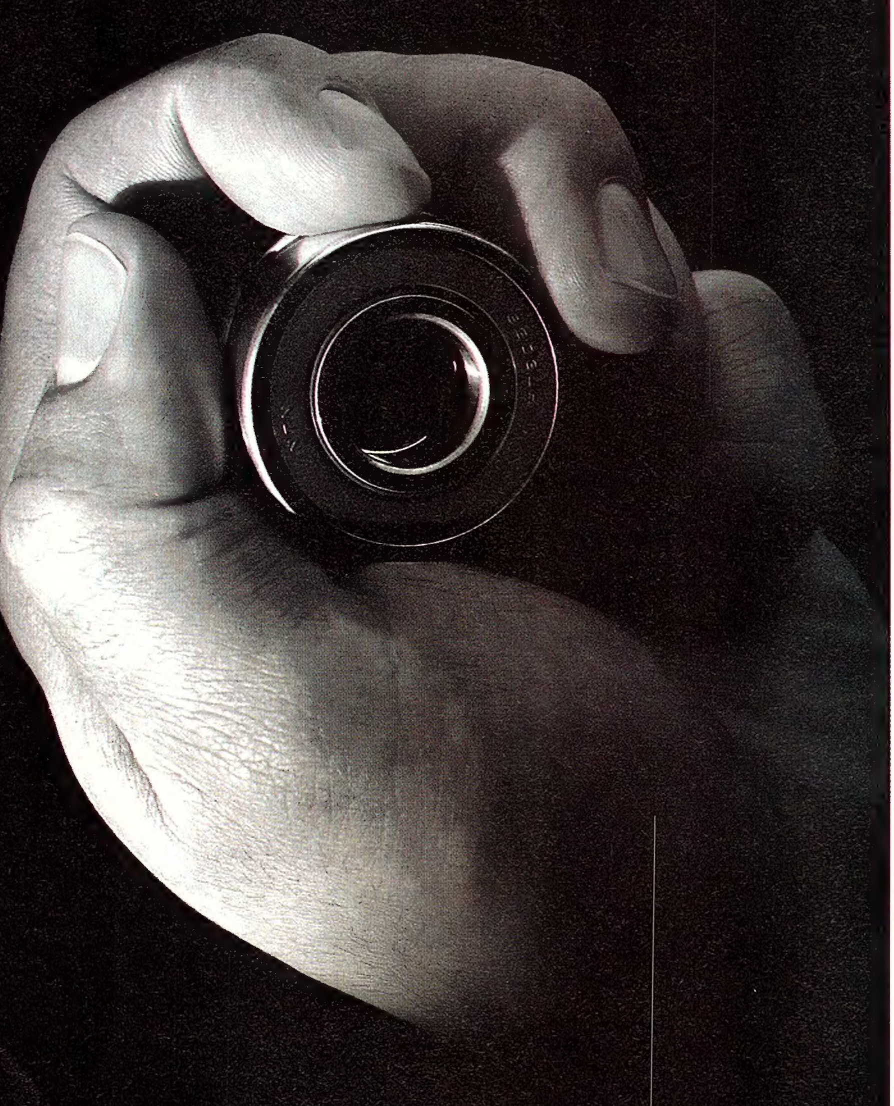
For a Gripping Solution to a Slippery Problem



“I felt like I was stuck in a Paul Simon song; we had a really good idea but it kept “slip-slidin’ away.” Somehow, we had to get a grip on it.

“While developing new timing belt idler pulleys for some of Detroit’s high performance auto engines, our idea was to mold a pair of NTN’s 6203 deep groove ball bearings into the pulleys to make a snug, secure, compact design. A really great idea, but in testing it threatened to slip through our fingers.

“The molding process couldn’t grip the bearings enough to keep them from slipping. As engine loads and temperatures increased, the nylon molded around the bearings’ outer rings expanded, losing its tight hold. The bearings would rotate inside the molded channels and the resulting camming action led to wear and premature belt and idler failures–not acceptable.

“So I called Tom Mohrdieck, our NTN Applications Engineer, for some ideas. We’ve always had a good relationship with NTN, but in solving this problem together we really worked as a team. After a few months of collaboration and testing, we hit on a solution that not only worked, but was a real innovation for this kind of application. Tom’s team at NTN refined the proposal for production feasibility and our guys tested it here at Dayco.

“What we ended up with was two bearings pressed inside a thin steel sleeve with four stamped holes. This force-fit assembly would ensure alignment of the two bearing outer races. The four holes in the sleeve fill with nylon during the pulley molding process and provide the tight, mechanical lock or “grip” required to firmly hold the bearings. No more slipping, no more problem, no more singing the blues.

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“Thanks to Tom and NTN, the song I’m hearing these days is “On the road again…” If you use bearings, use NTN. You’re not just getting a great product, you’re getting an engineering team that works for you as well as their bearings do.”

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designer's technology index

Your quick guide to this issue's vital editorial information

Technology/Company . . . **Page**

COMPUTER PRODUCTIVITY TOOLS
SUPER CIRCLE 491

AutoCAD software from Autodesk Inc. . . . 98
CATIA software from IBM/Dassault . . . 98
CFD software from Fluent . . . 63
Computer technology from Digital Equipment Corp. 77
COSMOS/M and FLOWPLUS software from Structural Research and Analysis Corp. . . . 44
3D Studio VIZ from Autodesk Inc. . . . 172
Form Z software from auto.des.sys Inc. . . . 172
Helix software from Microcadam . . . 98
I-DEAS software from SDRC . . . 98
Mechanical Desktop from Autodesk Inc. . . . 46
Printer from Ricoh Corp. . . . 124
Processor from Electronics Laboratory . . . 124
Reverse engineering software from Delcam Plc . . 124
Saber simulator software from Analogy Inc. . . . 113
Simulation software from UNITECH . . . 57
Software from Enerdis . . . 124
Software from Spring Technologies Inc. . . . 145
Unigraphics CAD software from Unigraphics Solutions . . . 78
Video measuring system from Shima America Corp. . . . 152

PLASTICS, METALS & OTHER MATERIALS
SUPER CIRCLE 492

Air duct system from Advanced Elastomer Systems . . . 36
Automotive body from Society of Automotive Engineers Inc. . . . 152
Blown film from JPS Elastomerics Corp. . . . 127
Composites from Rogers Corp. . . . 126
Dispensing system from Instrument Specialties Co. Inc. . . . 126
Elastomer from Sentinel Products Corp. . . . 32
Encapsulant from Emerson & Cuming Specialty Polymers . . . 127
Extra-soft TPE from GLS Corp. . . . 32
Heat-transfer fluid from Paratherm Corp. . . . 147
High-melt TPU from Stevens Urethane . . . 32
High-rebound TPU from BF Goodrich Specialty Chemicals . . . 32
Injection molding from Plastic Molding Technology Inc. . . . 145
Medical TPVs from Teknor Apex . . . 36
Noryl polystyrene from General Electric Plastics . . 78
O-ring design from Apple Rubber Products Inc. . . . 85
Plastic gear design from Ticona . . . 85
Pluracol polyols from BASF Urethane Chemicals . . 49
Polyimide from DuPont (U.K.) Ltd . . . 126
Resins from AlliedSignal Inc. . . . 127, 154
Soft-touch handles from DSM Thermoplastic Elastomers . . . 36
Surface coating from General Magnaplate Corp. . . 145
Synthetic lubricants from Anderol Co. . . . 150
Wire products from W.H. Bagshow Co. Inc. . . . 157
Zytel nylon 66 from DuPont Engineering Polymers . 65

TEST, MEASUREMENT & CONTROL
SUPER CIRCLE 493

Accelerometer from Endevco Corp. . . . 131
Accelerometers from Columbia Research Laboratories Inc. . . . 129
Anemometer from OMEGA Engineering Inc. . . . 131
Buffer from EG&G ORTEC . . . 150
Digitizer/analyzer from LeCroy Corp. . . . 131
Hardness testers from ELECTRO ARC Mfg. Co. . . 157
Hollow-shaft encoder from Ideacod S.A. . . . 129
Lens from Lens Innovation Ltd. . . . 131
Linear measuring system from Hepco Slide Systems Ltd. . . . 129
Loop calibrator from AMETEK Denmark . . . 117
Optical encoder from OakGrigsby Inc. . . . 129

Technology/Company . . . **Page**

pH meter kit from OAKTON Instruments . . . 157
PLL from Vectron Int'l . . . 147
Potentiometers from Noble U.S.A. Inc. . . . 152
Safety light barrier from Jay Electronique . . . 131
Shock absorbers from ACE Controls Inc. . . . 154
Strain gage technology from Measurements Group Inc. . . . 157
Test equipment from Specialized Products Co. . . 143
Testing database system from NAC Image Technologies . . . 156
Thermometer from Raytek Corp. . . . 117
Thermometers from OMEGA Engineering . . . 129

POWER TRANSMISSION & MOTION CONTROL
SUPER CIRCLE 494

Assemblies from Thomson Industries Inc. . . . 117
Ball and roller bearings from NSK Corp. . . . 90
Bearing components from Norton Advanced Ceramics . . . 151
Bearing from Lucas Aerospace . . . 132
Bearings from ESDU Int'l plc . . . 147, 156
Brushless servomotors from Pacific Scientific . . 148
Chains from Rexnord Corp. . . . 150
Drives from Cegelec . . . 133
Effecter from Norvell Rose, Race Intl. Corp. . . . 69
EPAS from Lucas Varity . . . 113
EPAS from NSK . . . 113
EPAS from SMI . . . 113
Frequency drive from KB Electronics Inc. . . . 157
Fuel cells from Int'l Fuel Cells . . . 61
Guidance system from INA Lineartechnik oHG . . 133
Guide actuator from THK America, Inc. . . . 91
Guide rails from igus GmbH . . . 125
Hybrid system from Delphi Saginaw . . . 113
Hybrid system from TRW . . . 113
Industrial encoders from BEI . . . 57
Integral bearings from NMB Corp. . . . 90
Linear guidance systems from INA Lineartechnik oHG . . . 143
Linear guides from Thomson Industries Inc. . . . 148
Linear module from Star Linear Systems . . . 152
Linear motor from Anorad Corp. . . . 143
Linear slides from Reliance Gear Co. Ltd. . . . 133
Long-life bearings from NTN Bearing Corp. . . . 91
Modules from National Instruments . . . 132
Motor from ITT Automotive Europe GmbH . . . 132
Motors from Lenze GmbH & Co. KG . . . 117
Motors/drives from Baldor Electric Co. . . . 151
Powerline filters from Wordsun Ltd. . . . 150
Servo wheel from Rockland Servo Wheels . . . 74
Servomotors from K&D Magmotor Corp. . . . 157
Step motor from Oriental Motor U.S.A. Corp. . . . 91
Stepper motor from Thomson Industries Inc. . . . 143
Stepper/servomotor brakes from Electroid Co. . . 143
Tracking system from Belt Technologies Inc. . . . 143

FASTENING, JOINING & ASSEMBLY
SUPER CIRCLE 495

Block connectors from HARTING Inc. of North America . . . 139
Bolt and stud extractor from Emhart Industrial . . 134
CD-ROM from WAGO Corp. . . . 143
Clamping system from Amacoil Inc. . . . 145
Coupling lines from Climax Metal Products Co. . . 157
Couplings from Oetiker Inc. . . . 147
Couplings from Rimtec Corp. . . . 72
Cutting systems from Miltec Corp. . . . 151
Drill bushings from Acme Industrial Co. . . . 145
Epoxy adhesive from Master Bond Inc. . . . 139
Extrusion from Velmex Inc. . . . 141
Fastener from Protex Fasteners Ltd. . . . 134
Fasteners from Penn Engineering & Mfg. Corp. . . 150
Gaskets from Schlegel Inc. . . . 157
Grab handle from Southco Inc. . . . 103

Technology/Company . . . **Page**

Interlocking system from Scientific Technologies Inc. . . . 139
Isolators/mounts from Barry Controls . . . 148
Knife assemblies from AZCO Corp. . . . 156
Large head rapier studs from DZUS/DFS . . . 103
Mag-form fasteners from Camcar Textron . . . 102
Markers from Borries Marking Systems . . . 141
Medical devices from Invest in Sweden Agency . . 152
Metric shaft collar/coupling from Ruland Mfg. Co. Inc. . . . 147
Miniature fittings from Beswick Engineering Co. Inc. . . . 156
Miniature fittings from Cotelco s.r.l. . . . 148
Open system from HARTING KGaA . . . 134
SCHWINGMETALL rivet mounts from ContiTech Formteile GmbH . . . 103
Steel R'ANGLE fasteners from Penn Engineering & Mfg. Corp. . . . 102
Stud Welding System from Emhart Industrial . . . 102
Subrack from VERO Electronics Inc. . . . 141
Tape from Parker Hannifin Corp. . . . 139
Welding equipment from Sonobond Ultrasonics . . 134
Workholding mechanisms from Speedgrip Chuck . 157
Workstation bridge crane from Met-Track . . . 157

ELECTRICAL/ELECTRONICS
SUPER CIRCLE 496

Bus cables from U.I LAPP GmbH Co. KG . . . 118
Capacitors and filters from Schaffner Altrac AG . . 119
Capacitors from Seacor Inc. . . . 119
Chokes from Vacuumschmelze GmbH . . . 117
Circuit products from CP Clare Corp. . . . 151
Coaxial connectors from Radiall Inc. . . . 156
Converter from Burr-Brown Corp. . . . 121
DSP boards from Blue Wave Systems . . . 50
DSP from Texas Instruments . . . 50
Electrostatic chucks from Sandia National Laboratories . . . 72
Fuses from Parker Hannifin Corp. . . . 148
IGBTs from International Rectifier . . . 121
Micro network controller from Omron . . . 91
Module from Rheinmetall Elektronik AG . . . 118
PLC compresses from Aromat Corp. . . . 90
Power components from Vicor . . . 119
Power supplies from Sola/Hevi-Duty . . . 121
Relay from Phoenix Contact Inc. . . . 121
Sensor from Interlink BT . . . 145
Sensor from TURCK Inc. . . . 119
Sensors from Kistler Instruments AG Winterthur . . 143
SRAMs from IDT Europe . . . 121
Switch from Airtrol Components . . . 121
Switches from Cherry Electrical Products . . . 118
Switches from Omron Electronics . . . 154
Switches from Sentrol Industrial . . . 119

FLUID POWER
SUPER CIRCLE 497

Air filters from Gardner Denver Machinery Inc. . . 150
Cylinders from Allenair Corp. . . . 123
Diaphragm pumps from KNF Neuberger Inc. . . . 122
Diaphragm valves from ITT Engineered Valves . . . 151
Fan from NMB Technologies Inc. . . . 123
Fans from Airflow Developments Ltd. . . . 123
Heat exchanger from ITT Standard . . . 123
Hydraulic pump from Hydronic Corp. . . . 123
Hydraulic pumps/power packs from Hydronic Corp. . . . 157
Module from Festo AG & Co. . . . 123
Pleat pack elements from PTI Technologies Inc. . 122
Pumps from Warren Rupp Inc. . . . 157
Valve from Air Logic . . . 123
Valves from Parker Hannifin Corp. . . . 122

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Do you design manufacturing?

Paul E. Teague
Chief Editor

As two separate stories in this issue on international technology describe it, Japan has shown the U.S. the importance of design for manufacturing. It saves time and money and can lead to higher quality.

Naturally, design for manufacturing isn't the most important thing in engineering. Innovation is critical for success as well. But if the factory can't make the product, you limit your success potential.

But how do you measure whether you are really designing successfully for manufacturing? For that matter, how do you measure whether you are leveraging the entire supply chain as you design products? International consulting firm Six Sigma has a way.

Measure your own success.

The firm has developed a questionnaire for engineers to guide their thinking process in product development. Here are a few of the questions, and possible answers. Choose one answer for each.

1. Prior to bringing a product to market, you can:
   A. Estimate the costs of raw material and assembly labor.
   B. Estimate factory yields and potential warranty costs.
   C. Predict total product life cycle costs and potential product profits.
2. When assigning part tolerances, you:
   A. Copy the tolerance block from a previous drawing.
   B. Use experience.
   C. Match the tolerance to the manufacturer's capability.
3. Your product manufacturing process:
   A. Is defined by the manufacturing organization.
   B. Uses concurrent engineering practices.
   C. Is jointly designed with the product.
4. Manufacturing cycle time is:
   A. Determined by the factory.
   B. Affected by part design.
   C. Is a design requirement.
5. Your design engineers:
   A. Have been given specifications to design against.
   B. Know the use of environment and have received input from the marketing department.
   C. Have met customers and understand their quality, cost, and volume needs.

If you chose C in each case, Six Sigma says you are leveraging the entire supply chain.

How do you measure your own design success?

Paul E Teague

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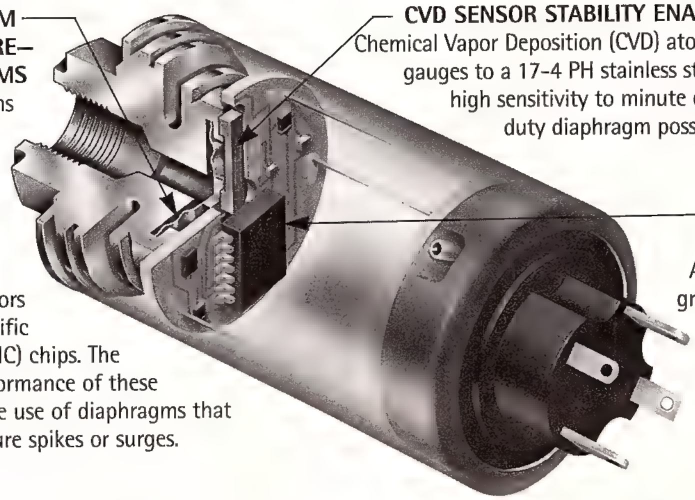

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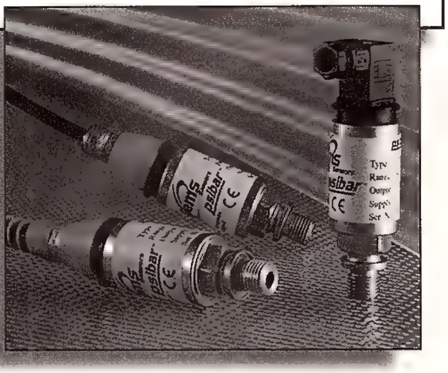

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Circle No. 164

letters to the editor

Readers state their views

Metric not costly

I've followed some of the recent letters both pro and con on metric. Although there may be some initial cost when first converting from inch-pound units to metric units, once the changeover is made, when a product is originally designed in metric units there is no increased cost at all.

If additional cost were a continuing consideration, why don't we see countries using metric convert back? The move to metric is the worldwide trend. Many countries changed in the 1970s while the U.S. held back. Now we are among the few nations that remain to convert. In fact there are benefits to standardization.

American measure is not binary! How about the factors of 12, 3, and 5,280 for length alone, as well as fractions of an inch. Or how about the awkward conversions like 8.35 lb/gal rather than 1 kg/ℓ for water density. Also, computers may use binary, but they still print out for us in decimal.

We can't buck the fact that our numbering system and virtually every monetary system in the world is decimal. I don't see that going away!

—Don Hillger
Colorado State University

Designing in metric easy

Regarding the metric controversy:

Metric is rational with units flowing from one measure to another with few oddities. English units are arbitrarily arranged with no constant or regular multiples. If the English units were binary, every unit would be twice the size of its smaller cousin: 2 inches to a foot; 2 feet to a yard; 2 yards to a fathom (this one is true!); 2 fathoms to a rod; and 2 rods to a mile.

I still can't always remember all the multiples in the English systems even after working as a toolmaker and tool designer. Now I work for a multinational company and find designing in metric much easier.

One writer asked about metric clocks. In the 18th Century the French Academy proposed a metric calendar and clock. The yearly calendar would have: 12 months to the year, 3 weeks to a month, 10 days to a week. The day would be divided into 10 metric hours (2.4 hours each), 100 metric minutes to the metric hour (1.44 minutes each), and 100 metric seconds to the metric minute (0.864 seconds each). The 24-hour day was too well-established and had just recently been standardized to convince everyone to throw out their clocks.

Send us your letters

Got an opinion on engineering? Want to add information to an article you've read in **Design News**? Tell us about it. We welcome your letters. All, of course, are subject to editing for brevity. And, you must sign the letter and tell us your company's name. Send them to Letters, **Design News**, 275 Washington St., Newton, MA 02158, or e-mail them to: jbroderick@cahners.com

Note: Opinions expressed are those of our readers and do not necessarily reflect the views of ***Design News.***

The writer should visit the Clock Museum in Rockford, IL. They have a 5th Century clock from China based on a 10 hour day, that's 10 hours from sunrise to sunset. It has cams that set the first hour at sunrise and the length of the hour for that day of the year. It must be an amazing clock, but not one I would like to live with.

English units have lost their chance to dominate the world, but the English Language is becoming the standard of business and computers.

—Carl Blum

Metric safety concerns

After reading the letters in the 4/20/98 issue about metric conversion, I have a very important reason (beyond being irritating) why converting to metric is a problem.

It is the engineer's job to ensure a product is safe. In most cases, computations are performed on critical aspects of a product. The "feel" an engineer has for the calculated values allow him/her to make a judgment about the correctness of a calculation. In other words, does the computation "make sense"?

Honestly, I have no idea what Pascal means in the physical world. However, I can instantly get a "feel" for a calculated value expressed in pounds-per-square-inch. Metric conversion will potentially make products unsafe.

—Ken Yasinski, CMfgE
Member of Technical Staff
Lucent Technologies
Norcross, GA

A new 'spin' on an old tire

What is so new on the Goodyear Tire (*Design News*, 5/4/98, p. 80)?

During 1964 I had a Thunderbird 1960, equipped with these so called Goodyear Double Eagle Tires. This tire had the regular valve and a soft blue patch for a needle valve in the side wall. Where are those tires?

—Horst Kiepen

Goodyear replies:

The Lifeguard Safety Spare, introduced in 1963 as the Goodyear Double Eagle tire, was a forerunner to the extended mobility technolgy used in the Eagle Aquasteel EMT run-flat tire. The Double Eagle was sometimes called the "tire with a built-in spare."

The Lifeguard provided double air-chamber protection. The inner chamber was inflated through a regular valve in the rim. The outer chamber took air through a self-sealing rubber valve in the tire sidewall, similar to the valves in footballs and basketballs.

The tires permitted a motorist to drive up to 100 miles after air in the outer chamber had escaped due to a puncture or rupture.

It was a complex process, since most motorists were confused by inflation pressure requirements for the two chambers. The tire also was difficult to mount as a three-piece assembly.

The Lifeguard was used as original equipment on some vehicles until 1969. Complexity eventually limited its commercial use. In 1965, Goodyear introduced the Lifeguard concept in its NASCAR race tires, which still use this run-flat capability.

Goodyear took a new route with its Eagle Aquasteel EMT run-flat tire by using a self-supporting tire construction with reinforced sidewalls to hold the vehicle off the ground, even without inflation pressure.

—Dave Wilkons
Public Relations Manager
Consumer Tires-North America
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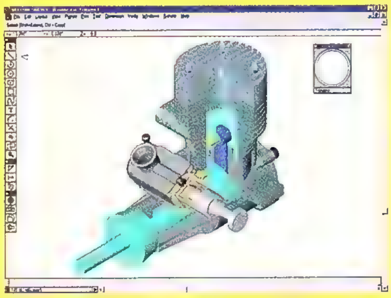

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Don't miss the next issue!

The August 3, 1998 issue of *Design News* will be packed with useful information on a variety of technologies that can help you do your job better. Here is a sampling:

- **MATERIALS.** What's new in recreation equipment? Plenty. And the enabling technology behind the new playthings is plastics. Our feature story describes the innovations, the engineering problems, and how engineers used plastics to solve them.
- **ELECTRONICS.** Two Design Application stories explore the electronics technology behind ultrasound and other medical equipment.
- **HYDRAULICS.** The hottest products in this traditional technology. You'll read about why they are important.
- **CAD.** You think your design cycle is short? Read how NASCAR racing teams use CAD to meet the demands of a design cycle that's only one week long.
- **POWDER METALLURGY.** Read how innovations are taking this technology to new markets.
- **PLUS,** Technology Bulletin will give you sneak previews of technology that may soon be available to the engineering community, Designer's Corner will show you more innovations through drawings that highlight new technology, and Software Lab will review a recent CAD release.

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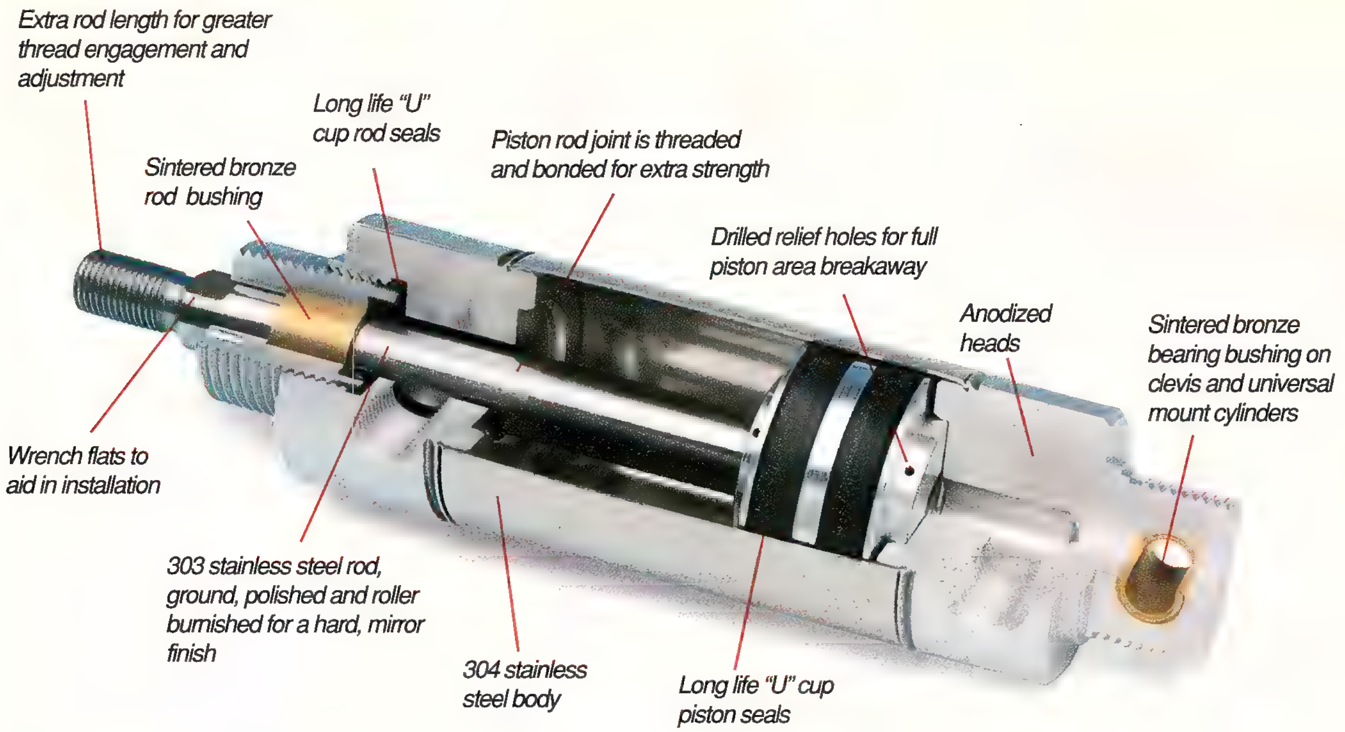
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Six wheels better than four

A steel six-wheel shopping cart with nylon webbing siding and child seat won the ninth annual National Engineering Design Challenge for a safer shopping cart, sponsored by JETS, a national, non-profit educational organization that promotes educational excellence in math, science, and technology in high schools. To prove its stability, three students balanced on the buggy's side during competition. The cart stood motionless. A novel six-wheel design is the key to the cart's steadiness. On the standard cart, the turning wheels are in the front and the pivot point is in the back, creating front-wheel steering. The diameter of the smallest circle it can make, therefore, is twice the cart's length. The Queen of Carts' two center wheels not only act as stabilizing wheels and keep the cart going straight, but also are the pivot point. The cart can turn from either end—from front or back around the center wheels. Also, while standard carts carry most of the load in the front over the turning wheels, making them difficult to maneuver under heavy loads, the Queen of Carts can easily carry loads up to 1,200 lb. Alysse Beutel, Patrick Flannery, Judith Luckie, Jessica Rudy, and Rebecca Wilson from West Perry High School in Elliottsburg, PA designed the Queen of Carts. FAX: (212) 967-7292, or Circle 576.

New wave of workstations on the horizon

Here's another entry in the workstation sweepstakes. Intel Corp. (Santa Clara, CA) introduced the Pentium II Xeon^{TM}, a line of processors for midrange and higher server and workstation applications. The 440GX-workstation chipset supports a front-side bus speed of 100 MHz, has an AGP port for graphics, and can support 2 Gbytes of memory. The dual 400-MHz Pentium II processor with 256 Mbytes RAM is built with a thermocoupler diode so OEMs can monitor core temperature. With this new architecture "Intel is bringing dual processing capabilities at affordable prices to the workstation market segment," says Raghu Murthi, director of product marketing, workstation product division, Intel. The price is $8,000. The dual Pentium II Xeon processor workstations will allow developers to do real-time configuration changes and rendering on one platform. The developer can continue designing on one processor while the second does the rendering as it is developed. It is also fast. "Applications will run 10 to 20% faster than the Pentium II processor workstations," Murthi continues. "Ours is the fastest processor on the market today, bar none." Workstations with the Xeon processor are ready for shipment. FAX: (253) 371-7129, or Circle 577

Sun's motherboard design breaks systems apart to rebuild

Sun Microsystems (San Jose, CA) isn't going to be left behind. The company developed a four-way embedded SPARC^{TM} multiprocessor board, the Ultra AXmp, using Sun's new Computer Core Technology (CCT). CCT combines core system ASICs, memory, and SPARC CPUs in a modular package. "This is the first time this building-block approach has ever been done," says Sun's Jeff Veis. With a modular approach, people can pick any flavor of I/O they want and design accordingly. "CCT allows designers to get back in the game," he says. By partitioning the core components of Sun's four-way architecture in a dense and modular package, the company can offer three times the computer density or one-third the size of an average office system, while increasing the integration flexibility for the embedded market. The Ultra AXmp can be deployed in an industrial, rack-mount chassis in either a horizontal or vertical orientation. The board, specifically targeted for telecommunications and networking OEMs, will be available in the second half of 1998. Embedded configurations start at $7,500 in volume quantities. FAX: (408) 544-0180.

LCDs make way for LEPs

Light-emitting polymer (LEP) technology from Cambridge Display Technology (CDT, Cambridge, England) may soon find its way into commercial flexible displays. DuPont (Anaheim, CA) and CDT entered into a two-year joint development agreement to supply plastic substrates coated with LEP material to electronics manufacturers in large volume within three years. CDT holds a patent on the LEP technology. Displays will initially be incorporated into products such as VCRs, CD players, mobile phones, lighted signs, and alarm clocks. LEP technology can be produced with existing manufacturing equipment, and still offer the low voltage benefits of traditional light-emitting diodes and the large area patternability associated with current LCDs. Phone: (302) 695-3332, or Circle 578.

Good things come in small packages, even lasers

Using chaos theory and an egg-shaped cavity, scientists from Yale University (New Haven, CT), Lucent Technologies Bell Labs (Murray Hill, NJ), and the Max

technologybulletin

Late developments that shape engineering

Planck Institute of Physics (Dresden, Germany) developed semiconductor microlasers with more than 1,000 times the power of conventional, disk-shaped microlasers. These tiny energy sources are 0.05 mm in diameter, or as wide as human hair. The researchers say the experimental lasers could either be used to speed up voice, video, Internet, and other forms of communication that use fiber-optic networks or become the basis for entirely new networks. The discovery could allow manufacturers to build computers that would operate with light instead of electrons, with fiber optics replacing wiring. Instead of using the traditional circular laser cavity, Yale physicist A. Douglas Stone suggested changing the shape to an oval or egg. "If it's a circular cylinder, a lot of the laser beam gets wasted and doesn't get out at all," Stone says. Experiments showed that, above a critical deformation level, the light pulses would travel in a bow-tie pattern. They suffer less internal reflection and emit light in four narrow, controllable beams. An enormous increase in output power accompanies this change, Stone says. Each beam has an output of 10 mW, increasing the laser's total output to 40 mW, compared to 40 microwatts in the round cylinder. FAX: (203) 432-2207.

Filter turns bubbling crude into Texas tea, black gold

Jed Klampet shot varmints to find his billion-dollar oil well. Teh Fu Yen, Ph.D., a professor of environmental and civil engineering at the University of Southern California School of Engineering, developed an inexpensive filter instead. "In preliminary tests, our filter removes as much as 60% of the sulfur [from crude oil] in a single pass," says Yen. To make the filter, an engineer heats a mixture of two metals to nearly 1,000F and sprays it through a nozzle. Emerging as a fine crystalline powder, this "intermetallic" substance is bonded to an inert substrate, such as carbon fiber. The coated substrate is then packed into a hollow glass cylinder—creating a large interior surface. The greater the surface, the higher the efficiency of the filter. To remove sulfur, Yen treats the intermetallic powder with particular chemicals to produce a crystalline structure containing small pits that match the size and shape of sulfur molecules. "The crystalline structure can sort out the bad without affecting the good," says Yen. "Analogous methods of nanotechology might also be used to remove nitrogen compounds, metals, and other impurities. South America, China, Canada, and certain republics of the former Soviet Union have large reserves of crude that are heavily contaminated with sulfur, metals, and other impurities. Intermetallic filters could purify such oils both efficiently and economically." By altering the crystalline structure, variants of the intermetallic filter might also be used to treat sewage and purify wastewater, Yen suggests. E-mail to tfyen@mizar.usc.edu.

Weather or not, it's safer flying

The weather channel may take to the air—much to the benefit of those of us who fly. Honeywell (Phoenix, AZ) and NASA are joining forces to create a worldwide aviation weather distribution and display network called AWIN, Aviation Weather Information System. There were radio transmissions in the past from ground control, says Dr. Charles Scanlon, senior research scientist for NASA, "but it is hard to put a radar picture into words." Combining digital communication technology with powerful yet small PCs, Scanlon hopes to drastically reduce aviation accidents within the next 10 years. "Weather is a factor in 30% of all accidents," he says. In-situ turbulence and forward-looking sensors will send information to Earth where turbulence maps will be generated and data linked back to the aircraft. All equipment must be flight-hardened, meaning no electromagnetic influences, must withstand so many G-loads of force, and will not catch fire. Initial implementation should be within five years. FAX: (757) 864-2034, or Circle 579.

Hide and go seek, robot-style

Since they conquered the task of programming "observer" robots to track "target" robots, Stanford computer scientists are tackling the more difficult problem of getting their observers to stalk robots on the move. The autonomous observer does more than follow its target around at a discreet distance. The spy robot continuously calculates where it needs to be to ensure that the target doesn't disappear behind a column or down a hallway. The robot measures distances to walls and furniture with a horizontal laser range sensor and uses this information to create a two-dimensional floor plan. A built-in horizontal video camera creates a series of overlapping three-dimensional views of the space. The robot combines this information into a 3D rendering of the area. The robot has a second camera focused on the ceiling to help it track its position. The target robot doesn't stand a chance of blending in, with a black-and-white pattern stenciled on every side. In an associated project with Professor Ruzena Bajcsy's group at the University of Pennsylvania, Chairman of Stanford's Computer Science Department, Jean-Claude Latombe and his students are developing an observer robot that can identify and track unmarked robots and people. The 4-ft tall spies are built by Nomadic Technologies (Mountain View, CA) resemble an upright tank vacuum cleaner without the hose. An additional grant from the Army will give the researchers four more robots. These smaller additions will allow the researchers to devise methods for deploying multiple observers. E-mail: latombe@cs.stanford.edu, or FAX: (650) 725-1449.

—Laurie Peach, Associate Editor

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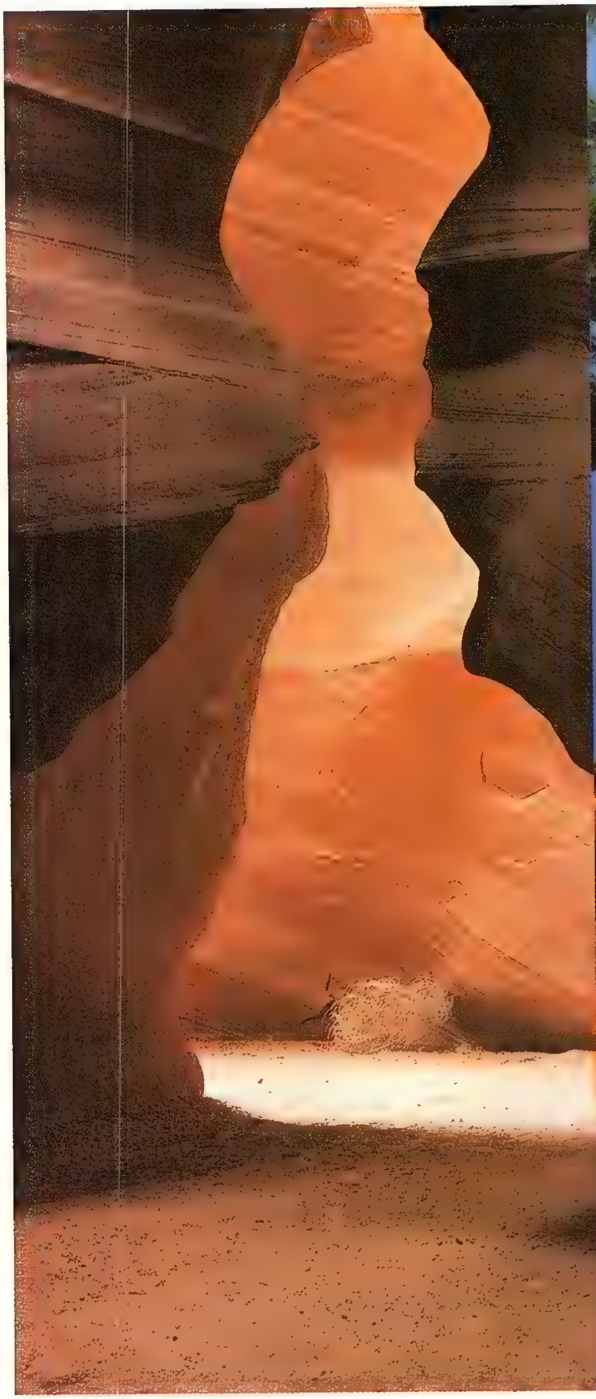

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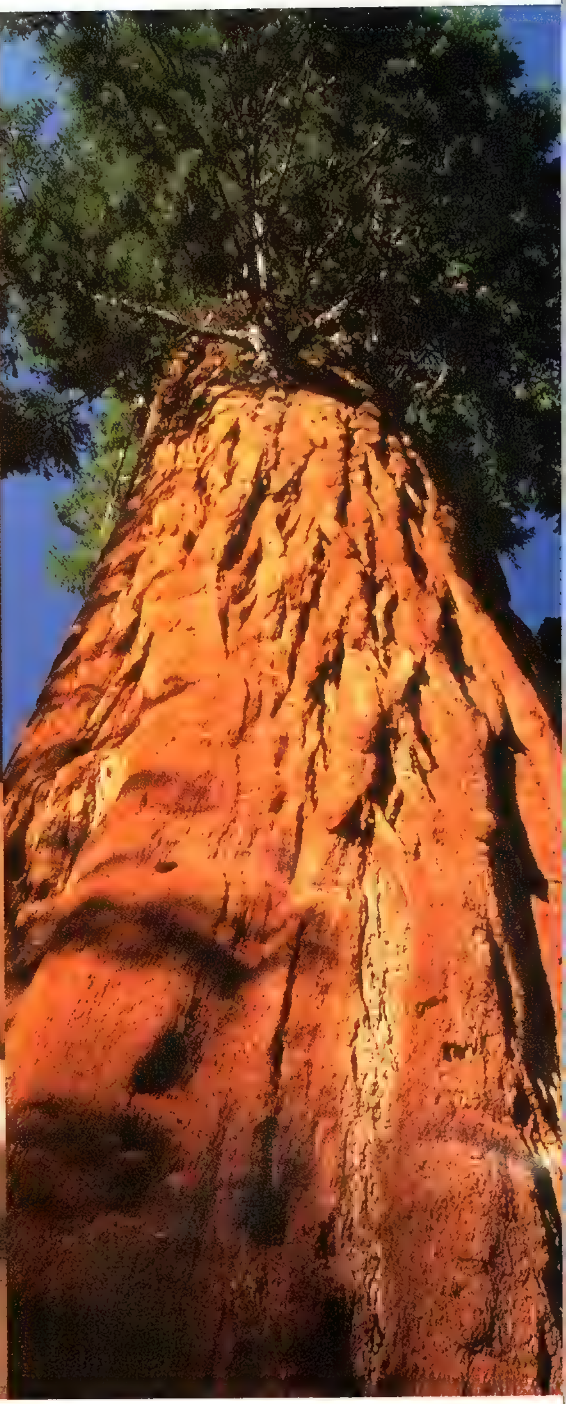

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Materials Editor Gary Chamberlain cites noteworthy elastomer products

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Elastomer becomes a lifesaver

Just how buoyant can a material be? In the case of a "new generation" of continuous cured and modified rubber compounds from Sentinel Products Corp., "they can outperform existing PVC/vinyl nitrile materials at a competitive price," according to Scott Smith, COO. The new elastomeric metallocene-based compounds, EMR™ 220FL, recently received UL recognition for personal flotation devices. They have a buoyancy rating of 60, provide softness properties similar to PVC/vinyl nitrile materials, and can be easily thermoformed into 3D parts. The compounds remain flexible at low temperatures, resist fungal and bacterial growth, and have high UV and chemical resistance. **Sentinel Products Corp.: Product Code 4372 or *Circle* *580***

High-melt TPU forms multi-layer laminates

If you have ever experienced a tacky mess when trying to bond laminates under high temperatures, Stevens Urethane has a solution with its new "super-high-melt" polyether thermoplastic polyurethane (TPU). Stevens ST-1665 is said to provide one of the highest melt temperatures available in a thin urethane film, between 190 and 210C. Because it requires a higher than usual temperature to become tacky and bond with other materials, its strength and barrier characteristics are not affected by processing temperatures that might melt "normal" urethane films. In multi-layer laminations, the material is typically used on the "high-heat" side of the lamination. The high-melt urethane maintains its integrity and performance properties, while films on the other side of the substrate soften and bond, forming a multi-layer lamination. **Stevens Urethane: Product Code 4373 or Circle *.581***

Extra-soft TPE 'grips' competition

When it comes to a thermoplastic elastomer (TPE) compound, softer often means better when it comes to touch. But does it still retain the "grippy" feeling required in many applications? If that product is DYNAFLEX® G-6725 grade from GLS Corp., the answer is "yes!" Made with Shell Chemical's KRATON® G polymer, the TPE is for insert molding, over molding, or two-shot molding onto harder DYNAFLEX grades. Typical physical properties of the 100% recyclable compound include a 25 Shore A hardness and a specific gravity of 0.089. Price: $2.45 to $2.98 per lb, depending upon quantity. **GLS Corp.: Product Code 4378 or *Circle* . . . . *.586***

TPU with more bounce per ounce

Can a hard ester and a high-rebound thermoplastic reside in the same family? They can when they are part of the new Estane® thermoplastic polyurethane product portfolio from BF Goodrich Speciality Plastics. The Hard Ester line includes extrudable materials that provide chemical resistance and a high-heat profile for dynamic, high-abuse applications, such as hose and tubing. The portfolio, which covers a range of hardnesses, is said to be more cost-effective than nylon. The High-Rebound TPUs offer "the first products in an innovative portfolio" for a variety of applications and industries. The materials exhibit improved tensile strength, strong tear and abrasion resistance, consistent properties, lot-to-lot scrap reprocessing, and recyclability of finished parts. **BF Goodrich Specialty Chemicals: Product Code 4374 or *Circle* . . . . *.582***

Materials 'air out' BMW air duct

Combine a hard polypropylene core and a soft, elastic sealing component and what do you get? For BMW, the material duo significantly cut costs for air duct systems versus previous ducts made of thermoset rubber, copolyester, and polypropylene. The BMW system requires high-temperature resistance and elasticity, as well as long-term properties to ward off chemicals and aging for under-the-hood operation. Using 3D/sequential blow molding, Santoprene thermoplastic rubber from Advanced Elastomer Systems (AES) is molded with a hard polypropylene/glass-fiber material. True to its name, 3D/sequential blow molding enables the production of parts in three dimen-

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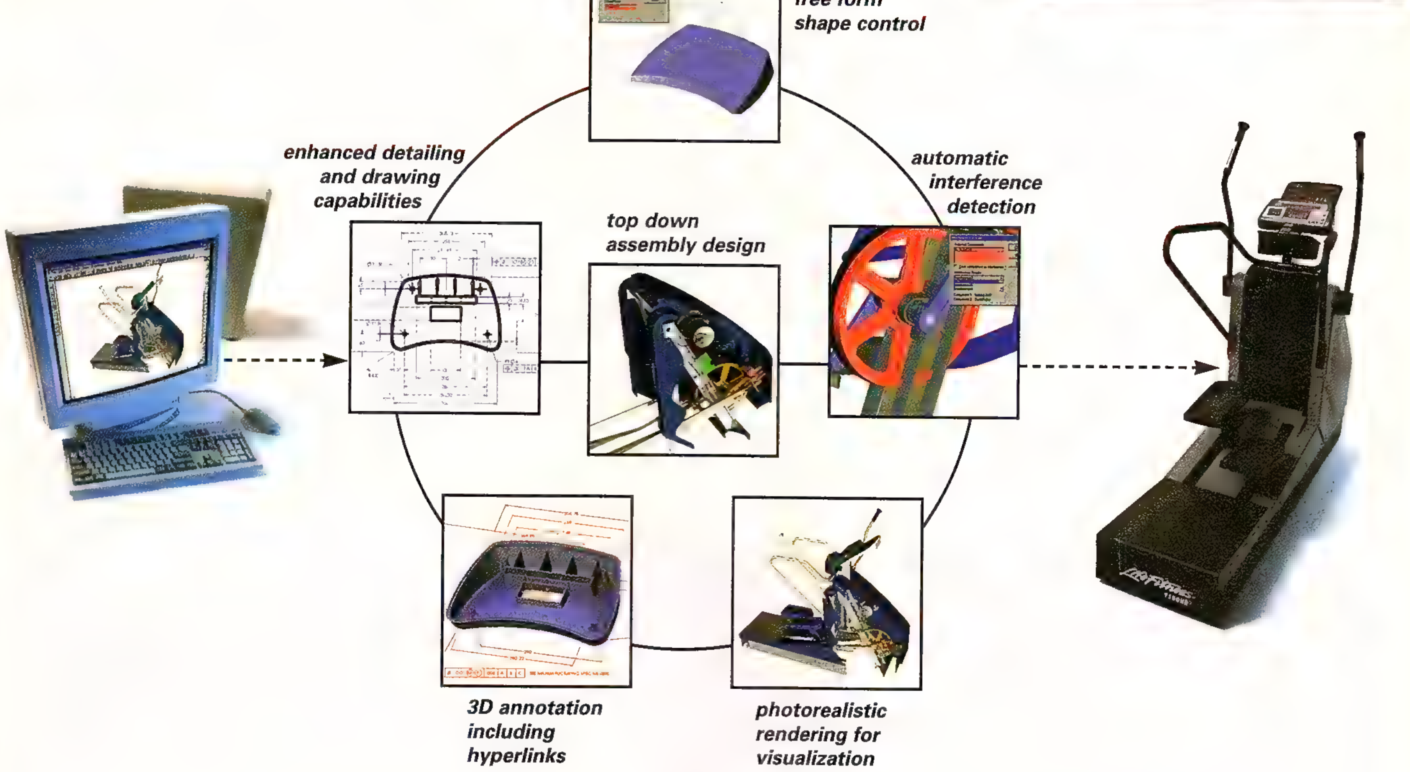
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Circle No. 171

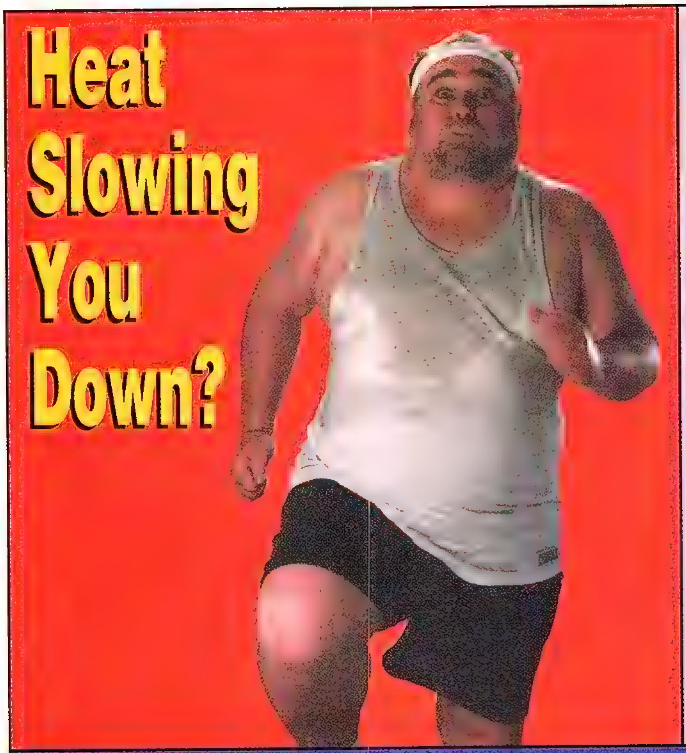
sions, while allowing molders to change from one material to another during the production of one part. "This application has excellent potential for automotive OEMs around the globe," says Juergen Gloeckler, AES' automotive director, Europe. **Advanced Elastomer Systems: Product Code 4375 or *Circle* 583**

Medical TPVs don't need drying

No longer will you need to pre-dry thermoplastic vulcanizate (TVP) elastomers used to produce medical devices or healthcare products—providing you turn to a new series of TPVs from Teknor Apex's Plastics Div. The Uniprene® 7010 Series compounds are nearly identical to advanced Uniprene materials recently introduced for general industrial applications. However, they have been reformulated with ingredients that conform to 21 CFR for medical and food-contact uses. Not only do the TPVs reduce or eliminate pre-drying because they absorb less moisture, but they cost less to color, since they exhibit less yellowness in natural (uncolored) form. Currently under evaluation are overmolded plugs in surgical cables and plunger tips for syringes. **Teknor Apex: Product Code 4376 or *Circle* 584**

Soft-touch adds sales appeal

Add a soft-touch to your products and you could add to your sales. That's what Warner Tools did when it introduced the ProGrip™ Series, an expanded line of paint scrapers and putty knives that feature soft-touch handles. Warner designers selected polypropylene for the hard handle substrate, then added SARLINK® 3460, a high-flow TPE from DSM Thermoplastic Elastomers, for the soft component, "because of its processing abilities, strong chemical resistance, and cosmetic appeal," says Warner Product Development Manager David Henke. A two-shot insert loading injection molding process was used to make the grip. Its popularity with decorative and maintenance pros proved so successful that Warner has decided to upscale its entire line of products using the SARLINK material. **DSM Thermoplastic Elastomers: Product Code 4377 or *Circle* 585**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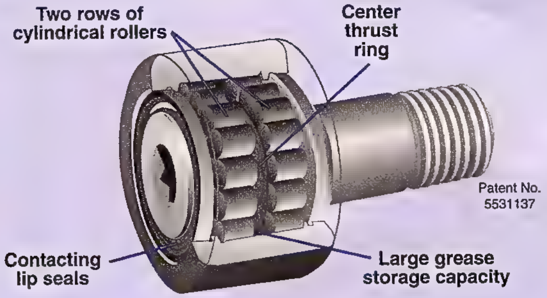
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Circle No. 173

standardsupdate

Technical news from around the world

Uncle Sam intensifies effort to invoke standards strategy

The National Institute of Standards and Technology (NIST) has stepped up its campaign to assure that U.S. innovations are not shortchanged by the system of international standards. NIST will host a conference on the issue in Washington, DC, September 23 in conjunction with World Standards Day. The agency hopes to develop "a reasonable plan for an effective national standards strategy to meet global goals in both standards and conformity assessment." Meanwhile, NIST has set up a special toll-free phone number (888) 591-TEST and an e-mail address of oiaa@nist.gov for reporting suspected standards abuses in dealings with the European Union. NIST especially wants to know of instances in which Europeans have required U.S. firms to repeat compliance measurements in Europe. Later this year a laboratory accreditation system that NIST has spearheaded becomes operational. NIST officials hope the system, called the National Cooperation on Laboratory Accreditation, will enable tests to be performed only once, with worldwide acceptance of the data.

How other nations out-maneuver U.S. on standards

Why is the U.S. government getting so concerned about international standards? Growing numbers of U.S. firms are finding trade gates swung shut as compliance with standards developed overseas becomes the price of admission. So complains NIST Director Raymond Kammer. Equally disturbing is the way foreign firms determine conformity with their standards. U.S. companies often must demonstrate adherence not just through testing at home, but also by duplicate, costly, and time-consuming testing overseas. "It is fair to say that European governments and industries believe they can create a competitive advantage in world markets by strongly influencing the content of international standards," Kammer contends. "Europe does have a strategy, and it is up running at full throttle."

Theme for 1998 paper contest: Guidelines for fee or free?

"Standards for Fee or Free: What Are the Consequences?" That's the theme chosen by the Standards Engineering Society for its 1998 paper competition. Contestants are to write between 2,500 and 4,500 words on the debate of oversales, pricing, and availability of standards. Each paper should make a case for whether U.S., regional, and/or international standards should be fee-based or provided free to all interested parties. This year's winning entries will be awarded during the annual World Standards Day Dinner on September 23 in Washington, DC. The author or authors of the winning submission will receive $2,500 and a plaque. Second and third prizes are $1,000 and $500, respectively. Because of the nature of this year's topic, the 1998 paper competition is open to anyone in the world and need not emphasize the U.S. perspective. You can obtain Internet entry forms and rules from www.ses-standards.org/paper_competition.html.

Butt-type couplers recommended for charging electric vehicles

A milestone has been reached in the long effort to establish a single charging standard for electric vehicles. After 18 months of testing and deliberations, a Society of Automotive Engineers (SAE) task force has adopted a charge coupler design based on butt-type contact technology. The design thus becomes part of the J1772 standard of SAE. The action sets the stage for marketplace competition in inductive charging systems. The task force also considered pin and sleeve technology, which the Japan Electric Vehicle Assn. adopted as the standard in Japan. SAE J1772 will continue to reference this standard.

Quest for better quality spawns new software, manuals, books

An array of aids is emerging for engineers who must meet the rapid growth of standards for quality management. SPSS Inc. has come out with Trial-Run® Windows software for design of experiments (DOE). The product offers 41 design methods for DOE, a branch of statistics that helps reduce variation and costs in manufacturing. Included are Taguchi, Latin Square, Central Composite, and Optimal. Trial Run evaluates your responses to a series of questions and leads you to the optimal design for your situation. To see Trial Run in action, visit www.spss.com/software/TrialRun/ on the Internet. Meanwhile, the third edition of the manual for the auto industry's QS-9000 series of standards is now available. Among additions are new test-laboratory requirements for in-house laboratories of suppliers. For more information go to www.aiag.org. Quality Resources (www.qualityresources.com) has updated two of its most popular books. The second edition of "SPC Simplified Workbook" provides case studies and exercises in statistical process control. The eighth edition of "Baldrige Award Winning Quality," by Mark Graham Brown, contains this year's revised criteria and a new chapter on preparing for a site visit from the board of Baldrige examiners.

—Walter Wingo, Standards Editor

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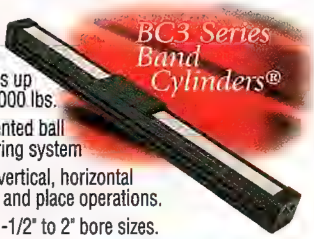

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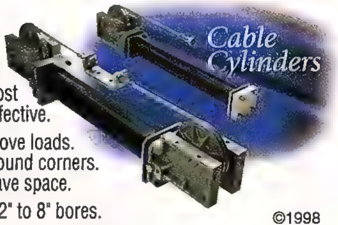

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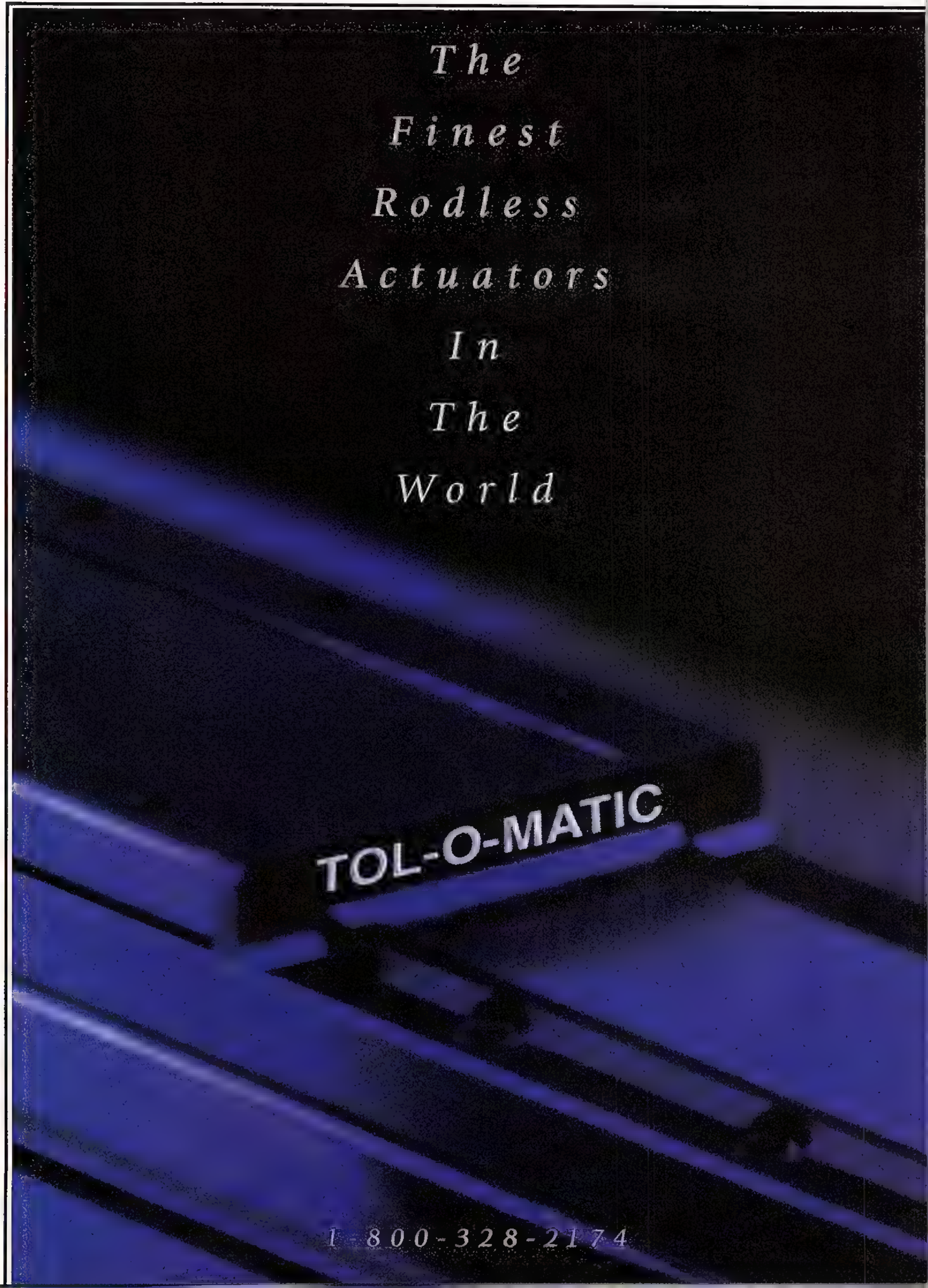

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A new brew for industrial control

Java programming language comes to embedded control

Cambridge, England—Imagine you are reading a book about circuit analysis. You encounter a circuit diagram that interests you. "I'd like to see how that one works," you say. To your surprise, the book responds by creating a simulated circuit in front of your eyes, complete with voltage and current indications. Not only that, it gives you tools so you can change components in the diagram and alter supply voltages. Up pops a virtual oscilloscope, which you use to check circuit behavior at various points.

Welcome to the world of interactivity brought to you by Java, a programming language launched by Sun Microsystems only a few years ago, and now used by more than 700,000 program developers around the world. Electronic books like the one described above may not be in your local bookstore yet, but they're not far away—just visit the World Wide Web.

To the lay person, Java looks pretty much like C++, today's most popular object-oriented language. But Java has more. One of its main features is automatic "garbage collection," a rather inelegant term programmers use to refer to the way Java frees up memory that is no longer needed by the program. This might not sound like a big deal, but to programmers it's a load off their backs. Moreover, the lack of good memory management is what computer viruses take advantage of to do their nefarious work. Java's inherent security prevents memory "leaks."

Java has another feature that works in tandem with it called the Java Virtual Machine (JVM). The JVM allows Java programs to run anywhere and everywhere regardless of the underlying hardware or computer operating system. JVM is only a few hundred kilobytes of code, but wherever it's running—on a PC, cell phone, or digital TV—any program written in Java can run. This is, in fact, Sun's main pitch to software developers: "Write once, run anywhere." Today, the closest most industrial control design engineers get to Java programs—called applets—is when they surf the Web.

Automation companies who design products to be configured or programmed by end users aren't about to introduce Java, or any other general programming language as an alternative to the familiar ladder logic or function block diagrams. Only in highly specialized areas, such as semiconductor manufacturing, or advanced control in chemical and petrochemical production, do sophisticated end users plot their way with languages such as C. For the vast majority of industrial engineers, who know Basic, C and Java are a little too far out of their experience base.

But go down one level below the end user, to the OEM design level, and another story about Java is unfolding. Sun Microsystems has promoted Java as a language for embedded control and says it will find a home in cell phones, smart cards, and automatic teller machines. The prediction is starting to come true.

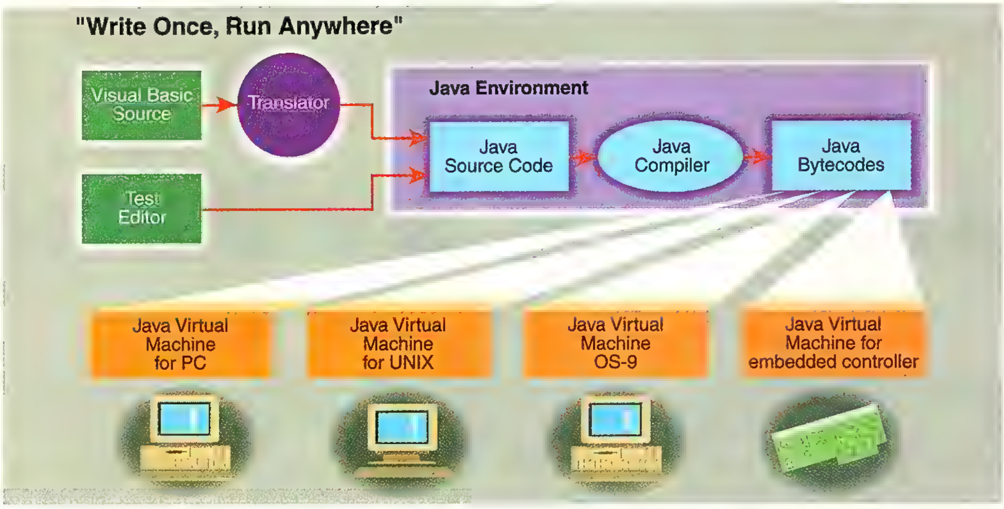
What this means to you

- *Specialized control-optimization can be embedded in distributed control systems rather than in "outboard" computers.*
- *Direct access to real-time plant-floor data using standard web browsers rather than PC-based human-machine interfaces.*
- *Inexpensive way to keep up with rapid changes in operating systems.*

Valmet, a large mill in Finland, uses Java as the base language for its paper-machine control system.

In Finland, Valmet Automation now uses Java as the base language for its complex paper machine control system. "We are thrilled with the opportunities for Java in process control," states President and CEO Markku Kangas, who says that his engineers have embedded the Java Virtual Machine into the process control stations of its Damatic XDi distributed control system (DCS). This is testimony to the confidence that Valmet places on the software, since the process stations require the highest reliability. The end user doesn't "see" the Java language; as far as he or she is concerned, the XDi is configured with the same high-level function block engineering tools as before.

Applet apps. Paper production involves the high-speed interaction of machinery and sensors from a variety of vendors, often involving several separate control systems with encapsulated proprietary knowledge. Specialized optimization packages provided by third party vendors run on "outboard" computers connected to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Java runs on virtually any computer, regardless of operating system or platform.

the DCS. But now "Java opens up Damatic XDi for third party, real-time control applications," says Valmet's Mika Vanne. "Mills and process equipment suppliers can embed their advanced know-how directly into Damatic by using Java."

Valmet has utilized this opportunity itself by developing an advanced multivariable paper machine control algorithm using Java with extremely promising results.

At development centers in France and the U.S., design engineers for Schneider Automation are using Java to implement what they call a web-centric control system that integrates a Modicon TSX Quantum PLC connected to a Java-powered operator interface. In doing this, Schneider demonstrates the potential for direct access to real-time plant floor data using standard web browsers in place of costly PC-based human-machine interface packages. The whole operation will become part of a larger scheme Schneider calls the "Transparent Factory," a heterogeneous computing environment in which controllers and computers communicate effortlessly via standard Internet protocols. Java's execution environment is attractive to control OEMs because it means they can incorporate Internet communication technologies into their products and still sleep at night.

"Java becomes the bridging structure for the Internet technologies applied to factory intranets," says Mark Fondl, sales and marketing director for Schneider Automation (North Andover, MA). A big Java advantage, he says, is that JVM handles the details of establishing TCP/IP (Internet Protocol) connections. To demonstrate how easy this is to do, Schneider engineers wrote and publicly demonstrated a 60-line Java applet that connects their PLC with a standard web browser. Primitive as the applet was, it allowed the operator to interrogate the status of certain PLC registers and turn on or off a lamp.

Keeping up with Microsoft. Industrial software companies who provide supervisory control and data acquisition (SCADA) packages have struggled for years trying to keep up with IBM and Microsoft as they switch, change, and upgrade their operating systems. Each change in Windows requires more investment in time and money to rewrite software so it remains compatible with the new version.

Because of its architectural neutrality, Java may be an end run around the operating-systems game, they say. In Tel Aviv, engineers at PC Soft Int'l took Sun's "write once, run anywhere" slogan to heart and recast their Wizcon SCADA package in Java, renaming it Wizcon for Internet. Sun Microsystems has certified it as "100 percent pure Java."

"Pure Java," says CEO Evyatar Meiron, means Wizcon users "can monitor their processes from anywhere using any platform and Java-enabled browser."

Another SCADA software supplier, SoftPLC (Humble, TX) uses Java extensively in its VIEWPoint product and invites application developers to write Java-based components to add functionality. Smart graphical entities, access to the Internet, database query, and supervisory control functions are all possible add-ons, according to Richard Hollenbeck, president of SoftPLC.

His company has specialized in software to program, supervise, and even emulate Allen-Bradley PLCs, and enjoys a following of some very technically competent developers and sophisticated end users. In fact Hollenbeck has no hesitation recommending Java for industrial control, even suggesting that Java subroutines could be created to work with ladder programs.

"We view Java as a superior alternative to Structured Text," says Hollenbeck, referring to one of the five languages specified by IEC-1131, a standard adopted by most PLC companies.

—Michael Babb,
Contributing Editor

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Analysis rides British racing circuit

Oxford, England—The major Formula One racing teams in Great Britain, like their counterparts elsewhere, have been using finite element analysis (FEA) to improve their car designs for several years. Now, some of the smaller teams are using it, too—and winning races.

In one of the first examples of the spread of FEA, two British engineering firms recently used Structural Research and Analysis Corp.'s COSMOS/M software to add stiffness to the chassis of their respective entrants in both Formula One and the British Touring Car championships.

Pilbeam Motor Sports Designs used COSMOS/M to design and analyze a roll cage for a leading contender in the world touring rally championship. Engineers had done the original CAD design in Bentley Microstation. Their analysis goal: add stiffness to the chassis within acceptable stress levels. In less than a week, engineers had created a design that doubled the car's stiffness over the original configuration, says Laurence Marks, of NT CADCAM Consulting, who worked with the team.

"Actually, the analysis took about two days, the time during which the engineers trained in the use of the software," Marks says. "They tried several options for adding stiffness before deciding on the final design." The team validated the analysis model with rig tests of the completed car.

"Previously," says Marks, "the team didn't use finite element analysis at all, so the software saved them considerable time and money."

Since the FEA work, the car has won several rallies.

Pilbeam also used Structural Research's FLOWPLUS computational fluid dynamics software to analyze air flow around the front of a car. The team then verified the analysis in the Motor Industry Research Association (MIRA) wind tunnel.

Engineers at TWR Formula One used COSMOS/M to find ways to add stiffness to this Volvo without exceeding stress levels. The Volvo is one of this years top entrants in the British Touring Car circuit.

Engineers at TWR Formula One, another engineering firm, also used COSMOS/M to add stiffness to the chassis of its Formula One, Le Mans, and British Touring entries. The latter, a Volvo originally designed with AutoCAD software, has one of the best records in the 1998 Touring championship circuit, which runs from March to October. Marks says TWR engineers performed the analysis in about four days with no training.

Speed of analysis and design is critical in racing, says Marks, because racing teams have very little time to spare. "The design time scale is something on the order of three frenetic months, although faster CAD-to-track times are often reported," he says. "The biggest change over the last decade has been the compression of analysis time scales and the associated reduction of costs, (thanks) to the ongoing increase in computing power available to the average user. Engineers can now run analyses on the same machines designers have on their desks." dn

For more information on COSMOS/M and FLOWPLUS software from Structural Research and Analysis Corp. (C):
Circle 533

American quiets older jets

American Airlines long-time workhorse, the Boeing 727-200, will have its takeoff and landing approach noise cut by reducing flap drag, airframe-produced sound, and engine thrust with Raisbeck Engineering's optimization system.

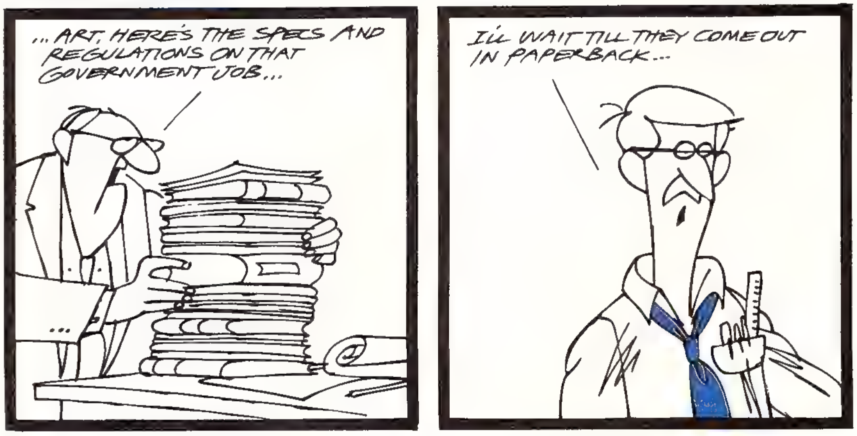
Dallas—American Airlines will outfit 52 of its fleet of 78 Boeing 727-200 airliners with the Raisbeck Engineering (Seattle) noise-reduction system, allowing the aircraft to comply with U.S. noise standards that go into effect on January 1, 2000 (DN 7/21/97, p.26). The system lowers drag and aerodynamic noise by reducing the degree to which the wing's leading- and trailing-edge flaps are extended during takeoff and landing. Thus engine thrust levels can also be trimmed, cutting engine noise as well.

The latest version of the Raisbeck system permits takeoff weight of 178,000 lb, up 11,000 lb from before, by optimizing (thus lessening) the leading-edge flap extension for the reduced trailing-edge values, not the original extensions with their greater drag numbers. The airline needed the higher takeoff gross weight for greater payload, range, and operational flexibility. The modified aircraft will be delivered starting this September.

Richard Cherney, American's managing director for fleet acquisition, says the 727s are currently used on routes north and east from the Dallas hub; south and east from Chicago; and along the east coast and in the Caribbean from Miami. Use of the Raisbeck Engineering kits will allow the airplanes continued use along these airways. dn

—Rick DeMeis, Associate Editor

STATE OF ART by Dave Harbaugh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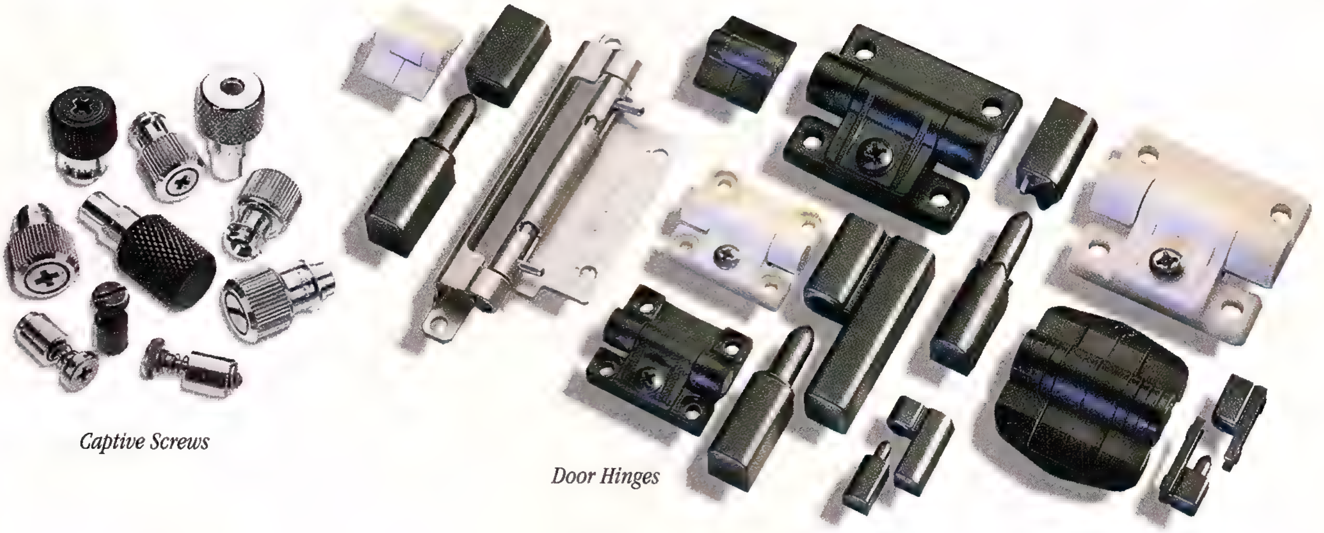
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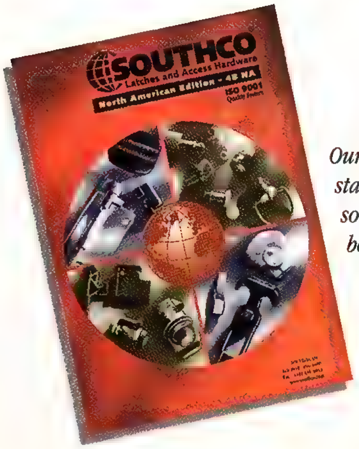

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Software expedites submersible design

R*ichmond, CA*—By leveraging the capabilities of advanced CAE software, designers of a new high-performance submersible were able to achieve an impressive four-month design-to-manufacture cycle. Though they had previously designed vehicles using AutoCAD's 2D capabilities, the engineers found that by using Autodesk's Mechanical Desktop they could not only expedite the design, but also get a better idea of what the final product would look like before building a prototype.

Called Wet Flight, the craft is the latest high-performance underwater vehicle to swim out the door at Hawkes Ocean Technologies (HOT). It's an innovative, one-person, wet (scuba diver-piloted) submersible designed as a mobile camera platform for underwater cinematography. Performance is said to exceed that of previous wet submersibles. With 14-hp thrusters, the 11-ft, 2-inch long craft can "fly" through the water at up to six knots. Stubby wings endow the 1,500-lb submersible with impressive maneuverability.

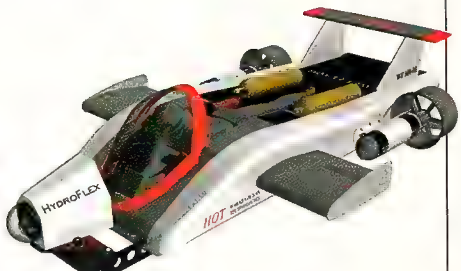
The craft and the company are the offspring of Graham Hawkes, recipient of *Design News'* Special Achievement Award in March 1997. He's designer of many of the world's finest submersibles and creator of Deep Flight, HOT's flagship submersible capable of diving to 1,000 meters.

While Deep Flight and Wet Flight are similar vehicles, they were designed in quite different ways. "From an engineering perspective, the design of Wet Flight was the first time we used Mechanical Desktop," says Eric Hobson, HOT mechanical engineer. Team members exploited a suite of Autodesk tools, using Mechanical Desktop for 3D design and AutoVision and 3D Studio for visualization studies. "Designing in 3D in real-time was a strong advantage on this project," he says.

A critical part of Wet Flight's design was obtaining visuals to keep the design on track. Throughout the development process, engineers were able to quickly obtain 3D models and renderings that accurately represented what the completed design would look like. "In real-time, we could make design decisions on the fly," Hobson says. "For us, this capability was a milestone."

Wet Flight is a smaller version of Deep Flight and uses many of the same components. Packaging these parts within a smaller structure presented some interesting challenges. Wet Flight's exposure to the elements also required housing the electronics in cylinders fixed to the sub's walls. The design process was simplified by exporting Deep Flight's AutoCAD files into Mechanical Desktop. Engineers then performed several iterations, evaluating several design variations before manufacturing a single part.

The submersible's frame is made from black polypropylene, which has a slight positive buoyancy. "It's an ideal material because of its buoyancy characteristics," Hobson says, "and it's lightweight yet strong and shock-resistant."



Autodesk's Mechanical Desktop helped engineers at Hawkes Ocean Technologies to design the Wet Flight submersible in just four months.

He used AutoCAD to draw the patterns for the frame, and plotted them full size to help cut wood templates. Polypropylene parts were then cut from the templates.

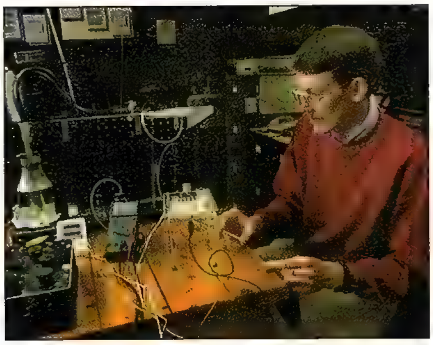
Wet Flight has already found application in the movie industry as an underwater camera platform for an IMAX special project called "Dolphins: The Ride."

For more information on Autodesk Mechanical Desktop (C): **Circle . .534**

Fuel cell targets consumer electronics

L*os Alamos, NM*—If Robert Hockaday's dream comes true, not only will your next automobile be fuel-cell powered, so will your cell phone. Hockaday resigned his position as a researcher at Los Alamos National Laboratory in 1997 to form Energy Related Devices (Los Alamos, NM), a company dedicated to the development of a Micro-Fuel Cell that he's been tinkering with for nearly 18 years. The goal: make a low-cost fuel cell that runs on methanol or ethanol and could power a cell phone for 100 hours of talking or 40 days in standby mode from just 1.5oz of fuel.

Key to the Micro-Fuel Cell's success is a low cost manufacturing method which uses a printing process similar to that used to produce computer chips. It's a "surface replica" fuel cell, and consists of three porous membranes. The central one is fiber reinforced; the outer two membranes perform water regulation and circulation. Electrodes are formed on the central membrane by depositing thin-film catalyst and metal electrode materials onto both sides of its surface via ion or light bombardment, etching, or vacuum thin film deposition.



Engineer Robert Hockaday hopes to develop a small, inexpensive, methanol-powered fuel cell for portable electronic devices.

Hydrophobic films deposited over the electrode films control the position of the electrolyte and strengthen the electrodes. Catalyst active surface area is maximized by separating the catalyst film from the porous substrate and then filling the intervening volume with electrolyte. Supplying fuel gas to one electrode and oxidizer gas to the other drives the cell.

"Exhaust" consists of water vapor and carbon dioxide. Hockaday claims the fuel cell itself is benign enough to be nearly edible.

Manhattan Scientifics (New York) has backed the venture in the form of a $1 million merger. Hockaday expects to have a prototype suitable for testing in a cellular phone or laptop computer within a year.

—Mark A. Gottschalk,
Western Technical Editor

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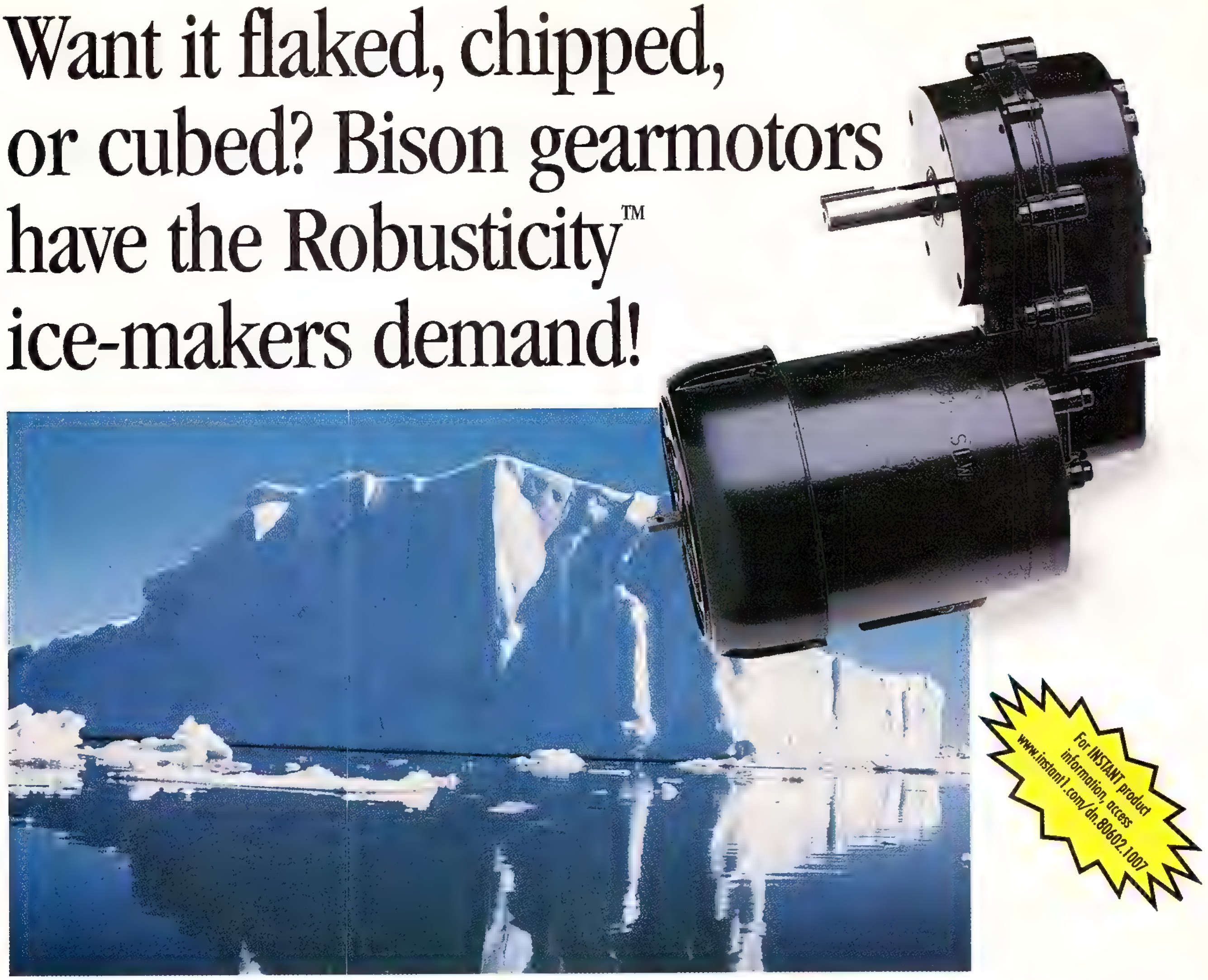

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Running track designed for records

Hunt Valley, MD—Highly trained and conditioned track athletes garner media attention, and shoe-company endorsements. If they are exceptional, they set world records. Rarely, however, does anyone take notice of those who lay the foundation for their success—the designers and builders of specialized running tracks around the world.

Martin Surfacing, a company that makes indoor and outdoor athletic surfaces, is one of those unsung heros. A far cry from the cinder-covered tracks of old, running surfaces installed by Martin normally consist of several layers of materials, each engineered to impart specific attributes (resiliency, bounce, durability, and aesthetics). The material most often used by Martin's top-of-the-line tracks—a polyurethane system based on Pluracol® polyols supplied by BASF Urethane Chemicals (Mt. Olive, NJ).

"A new running track under construction at a nationally prominent sports complex in Orlando is based on these polyurethane products," notes John Beynon, Martin president and CEO. "The properties possessed by the polyols enable us to design an ideal running surface that meets the exacting specifications of the facility, as well as the guidelines for professional and amateur running tracks."

Performance standards of International Amateur Athletic Federation (IAAF) outdoor tracks include: a force reduction of 35%, modified vertical deformation of 1.1 mm (±0.1), and Transport and Road Research Laboratory (TRRL) skid resistance of 69 (±1). Tensile properties are: 0.82 MPa, with elongation at break at 99%.

A licensed surveyor checks the tolerance for each professional-grade track in order to certify it for competition. "When you are designing and building a track that may be the venue for world-class competition, it has to meet very stringent guidelines in the event a world record is set," explains John Schedler, Martin's project manager for the new Orlando sports complex track.

The track Schedler refers to is Martin's ISS 1000 encapsulated system, the primary component of which is polyurethane, covered with a granular material for grip, and then painted with a durable coating. The base surface consists of four inches of crushed stone topped with three inches of asphalt. This is followed by an 8-mm-thick polyurethane layer and a 5-mm layer of spray-applied polyurethane.

"The ISS 1000 is designed to provide a resilient surface that can be used for training or racing," Beynon adds. "Because it provides a precise amount of cushion tailored for training purposes, it's easier on the athlete's legs, reducing common injury problems such as shin splints."

For more information on Pluracol polyols from BASF Urethane Chemicals (M):
Circle 535

WINNING RUNNING TRACK SURFACE FORMULA

	Units	Accuracy	Result	IAAF Specification Value
Surface thickness				
Recorded for effects on dynamic properties of the surface	mm	±0.5	13.5	AVERAGE >12 MINIMUM 10
Force reduction				
Test conducted at temperature ranging from 10-40C	%	±1	35.0	35-50
Modified vertical deformation				
Test conducted at temperature ranging from 10-40C	mm	±0.1	1.1	0.6-1.8
Friction				
TRRL Skid resistance	-	±1	69	≥47
Tensile properties				
Tensile strength	MPa	±0.02	0.82	≥0.5
Elongation at break	%	±2	99	≥40

Martin Surfacing's encapsulated track system, based in polyurethane polyols, meets or exceeds the International Amateur Athletic Federation's specifications for synthetic surfaced outdoor facilities.

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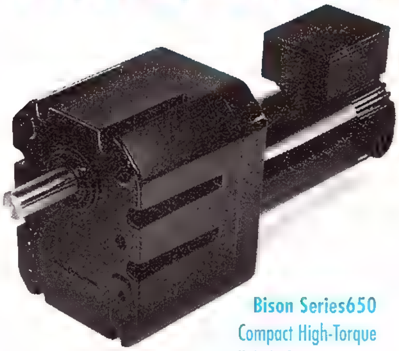
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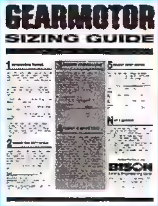

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Circle No. 188

DSP board enhances instrument design

Lexington, MA—Oxford Instruments is using a PCI-based digital signal processor board in Synergy, a non-imaging diagnostic system used to study how nerve cells receive and transmit information. The PCI/C44S DSP board enables Blue Wave Systems (Leicestershire, England) to create an open, modular system that accommodates tests of varying complexity.

"The PCI board offers sufficient performance to enable real-time processing of incoming test signals," says Dr. Martin Nichols, principal engineer on the Synergy project, "and thereby provides clinicians with a much more effective diagnostic tool than previously available."

In designing Synergy, the company concluded that a system based on PC technology would be user-friendly and easily accommodate add-on features such as multimedia and networking. Oxford Instruments also wanted to allow for future I/O expansion and the option to extend the number of processors from one to a maximum of four.

Blue Wave Systems' PCI/C44S board meets these requirements. "It allows one to four DSPs, dependent upon the instrument's configuration, and offers flexibility, matching of processing performance to different product configurations, and off-the-shelf availability," says Nichols.

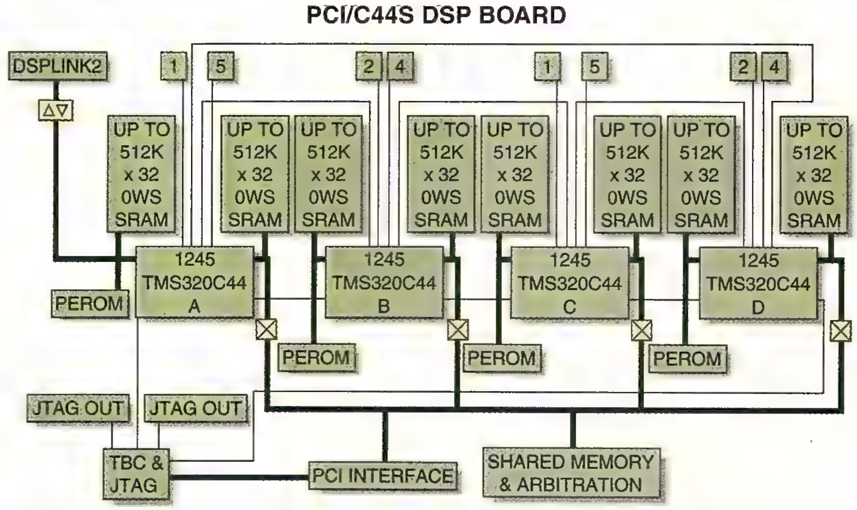
In use, the Synergy system applies an electrical stimulus to the patient's skin and measures the electrical response of the muscles. These patient analog signals are digitized in the headbox, a specialized digital-to-analog converter and amplifier unit, at sample rates up to 200 KHz. The signals are then transferred to the PCI/C44S DSP board, which analyzes the data and passes the results to the PC for real-time display and archiving.

"This real-time capability is extremely important as physicians need audio and visual information to appear at the same time, with no perceptible delay between them," says Nichols. "In achieving this, it becomes much easier to relate what's happening physically to the patient, to what's happening on the screen."

Blue Wave Systems created a workable interface and replaced a standard I/O which would not connect with the DSPLINK2 connector, a 32-bit interface that provides expansion capabilities to a range of peripheral modules. The DSPLINK2 connector was replaced with two connectors—one provides the DSPLINK2 functionality, the other provides access to COM ports, controls and gathers data from the daughterboard.

The PCI/C44S takes advantage of Texas Instrument's floating-point TMS320C4x parallel DSP chip for fast parallel DSP processing and real-time embedded applications. It can be populated with up to four 50- or 60-MHz TMS320C44 processors, and provides a PCI interface and shared memory accessible by the host PC.

For more information DSP boards by Blue Wave Systems (E): **Circle 536**
DSP from Texas Instruments (E):
Circle 537



PCI/C44S DSP BOARD

The PCI/C44S DSP board used in Synergy features up to four 60-MHz TMS320C44 processors for fast parallel DSP processing and real-time embedded applications.

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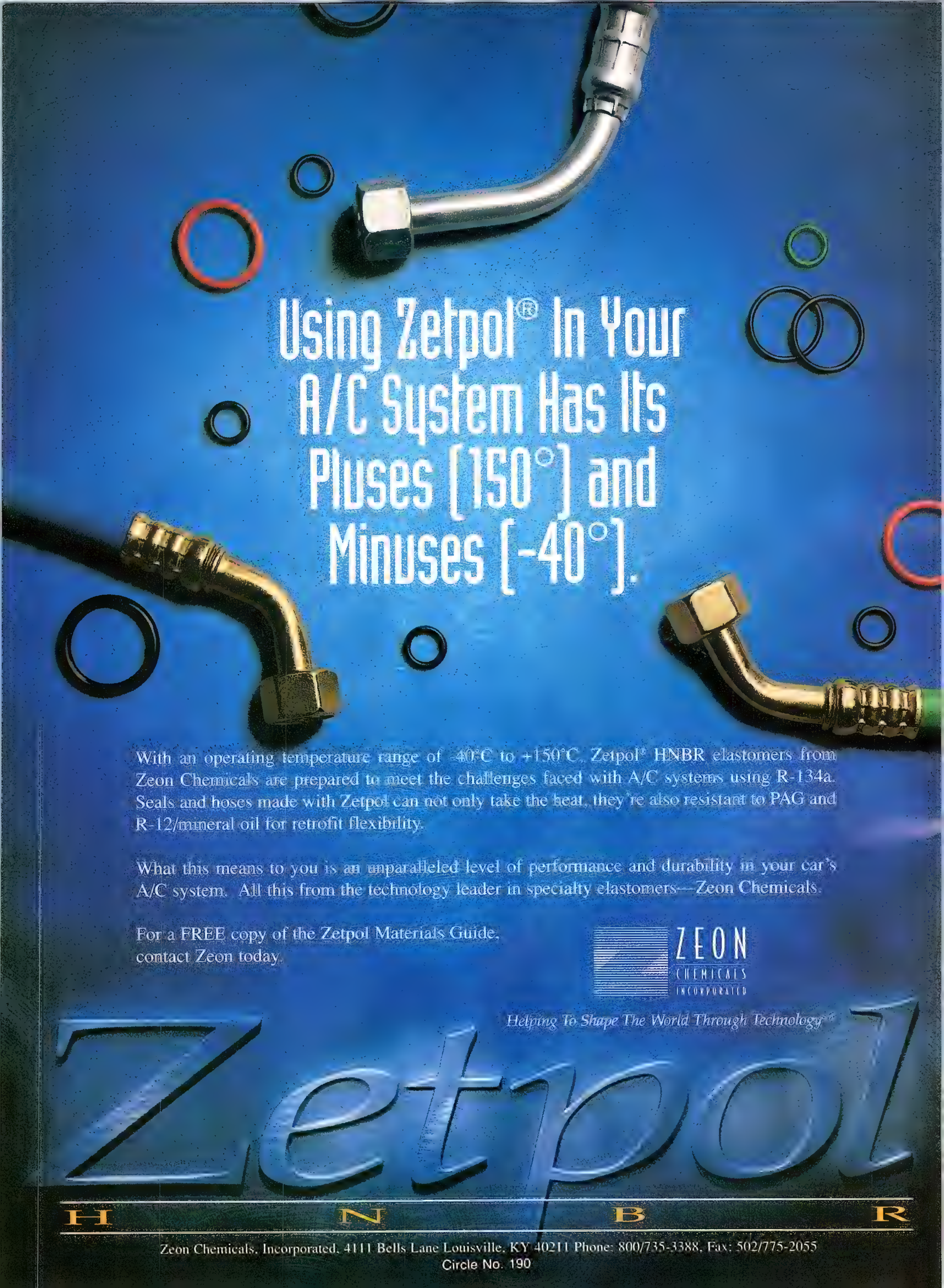
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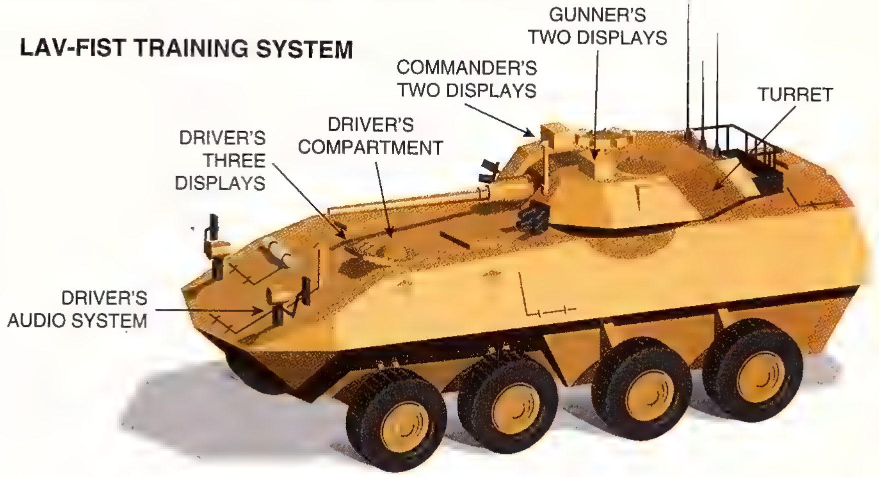
Circle No. 190

Appended trainer leverages defense dollars

Winter Park, FL—How do you maintain proficiency of Marine Corps Reserve Light Armored Vehicle (LAV-25) crews when funds for such training are cut back? Universal Systems & Technology, Inc. (UNITECH) Training and Simulation Div. and its subcontractor Raydon Corp. (Daytona Beach, FL) provided the answer by using the vehicle itself as part of training simulations. Not only is the cost of a full-blown simulator saved, but an added bonus is the rugged, portable training system appended to the vehicle accompanies the leathernecks on shipboard deployments—allowing up-to-the-minute, objective-specific training on the way to any global hot spot. Simulating vehicle use also reduces wear and tear on equipment and thus maintenance costs.



Each of the three light-armored-vehicle crew members has dedicated appended training displays and control system 'overlays' to provide the look and feel of vehicle operations.

The LAV-FIST (Full-crew Interactive Simulation Trainer) consists of hardware and software to hone the gunnery, crew communication and coordination, and mission tactical skills of the crew members. These tasks include: reconnaissance and reporting procedures, map reading and navigation, and calls for artillery fire. Target acquisition, aiming, and firing the main 25-mm automatic cannon and its coaxial 7.62 machine gun can be simulated. Sensors overlaid on the driving controls feed visual representation of vehicle movements into the displays, as do the turret controls, while the vehicle and turret remain stationary. Sounds that replicate vehicle and turret operations aurally heighten realism.

CRT-monitor displays, two each for the commander's and gunner's view out of

Continued on page 57

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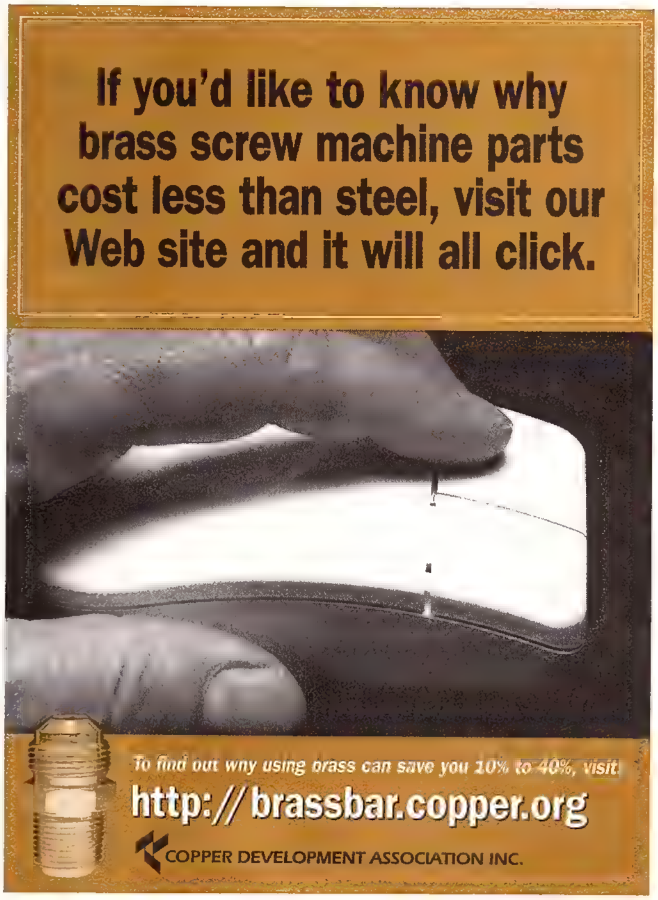
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Circle No. 193

Continued from page 55

the turret and three for the driver's station in front, provide visual cues and simulate day and night operations. A Lockheed Martin SE 1000 image generator, repackaged to fit a standard two-man portable container, supplies the computer graphics. The commander's helmet-mounted display uses an Intersense (Burlington, MA) inertial-motion orientation sensor rather than the usual magnetic system because of the metallic LAV structure.

A single instructor/operator (I/O) trains the crew with the FIST. The I/O station allows selection of weather conditions, time of day, composition of friendly and enemy forces, ammunition quantity, time standards, and vehicle locale. The system's Compaq (DEC) Alpha host computer can "drive" the vehicle to train just the commander and gunner, or can teach the gunner alone. Commercial 120V, 60 Hz, 30A power is supplied externally to run the simulation and vehicle systems—eliminating any use of vehicle electric power with its hazard potential of inadvertent vehicle travel or turret movements—and avoiding complex patching into vehicle hydraulics. Modular design allows a crew of three to set up the FIST in two hours. And Rick Wrenn, UNITECH project manager, says this includes cabling for video, audio, sensors and controls, data, communications, power, and Ethernet.

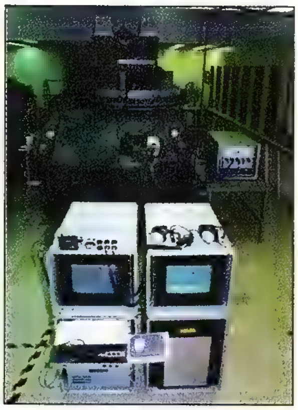
He also notes some of the adaptations made to provide realistic control-force feedback. For steering, the steering linkage is dropped and an appropriate torsion spring brake added to produce steering-column "feel." A BEI (Goleta, CA) encoder on the steering wheel (also used on the gun elevation and traverse controls) provides feedback to the visual displays and simulated systems. A separate odometer, tachometer, and gearshift are used, however, since these mechanisms do not function when the vehicle is not literally running. Interestingly, Wrenn adds, the appended brake and accelerometer sensors were adapted by a sharp-thinking design engineer who found suitable units at an auto parts store. The rugged EGR valve sensors are economical to buy but built for a demanding environment.

LAV-FIST simulator use has given Marine units more productive "live fire" when actually using the vehicles, as well as more quality combat-training time. Potential civilian applications for appended trainers may include such "high-risk" systems as emergency vehicles and locomotives. dn

—Rick DeMeis, Associate Editor

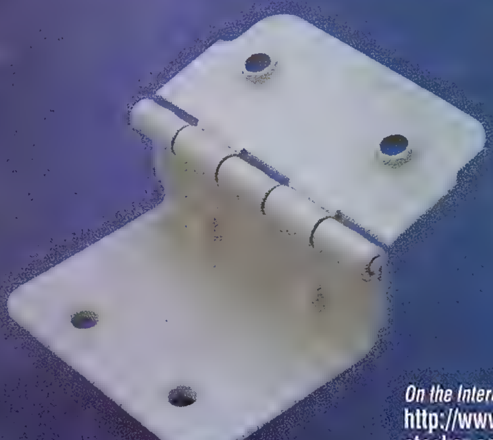
For more information on simulation software from UNITECH (C): Circle . . .538

Industrial encoders from BEI (P): Circle 539



The Full-crew Interactive Simulation Trainer (FIST) knocks down and is stored within 15 two-man portable cases, four forming the instructor/operator station (front), and one serving as the vehicle interface cabinet (right). The modular system allows transport and training during armored-vehicle shipboard deployments.

HINGE
Design Problems?



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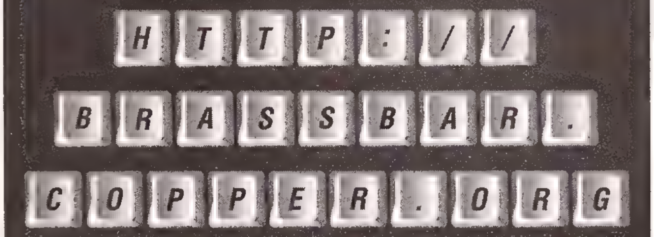

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Circle No. 195

Award sponsors support top engineers

Engineers celebrated their design innovations at the *Design News* annual awards banquet, held at the Ritz-Carlton, Chicago in March 1998. Brian Muirhead (center), flight systems manager for the Pathfinder mission received his award for Engineer of the Year. Others honored include robot designer Red Whittaker (left), recipient of the Special Achievement Award; and Horst Maack (right) of Cincinnati Milacron, Engineering Quality Award winner.

Newton, MA—Engineering companies back the yesterdays, todays, and tomorrows of technology by supporting the *Design News* Engineering Awards program, now in its twelfth year.

The Torrington Co. (Torrington, CT), leads the way in its twelfth year of support with a $25,000 award for the Engineer of the Year. The honoree, selected by *Design News* readers, brings a career history of innovative design work to the engineering industry. The most recent winner, Brian Muirhead, received the 1998 award for his work as the Mars Pathfinder's flight systems manager at NASA's Jet Propulsion Laboratory (Pasadena, CA).

"There is a high level of pride throughout the Torrington Company regarding our participation in this outstanding and prestigious program," says Milanne Miles, marketing communications manager. "We have a unique opportunity to honor some of the country's most-talented engineers, people who have made significant contributions to our nation's advances in science and technology." She adds that "even more gratifying, Torrington is able to provide valuable financial assistance to the Engineering Education Foundation (EEF) to help promote excellence in a critically important field, one that will help maintain America's global leadership into the 21st century."

Milanne Miles, marketing communications manager, The Torrington Co.
Contribution: $25,000 grant

Backing the awards for its ninth consecutive year, NTN Bearing Corp. (Des Plaines, IL) has increased its grant from $15,000 to $20,000. This gift for the *Design News* Special Achievement Award winner is donated to the college of his/her choice. Editors select this honoree based on outstanding lifetime achievements in the engineering field. The 1998 recipient, William "Red" Whittaker, is a leading designer in the world of field robotics.

"Recognizing and publicizing the contributions of our pacesetting engineers is vital if the engineering profession is to compete effectively for the attention of young people choosing a career," says George Hammond, president of NTN Bearing Corp. "Supporting this award program helps everyone to see the design engineer as a role model for future generations."

The Engineering Quality Award, received this year by Horst Maack for his centerless grinder design, is being supported for the tenth year by Schneeberger Inc. (Bedford, MA), a producer of precision bearings. Its $20,000 grant, a $5,000 increase from last year, is presented to the school of the 1999 winner's choice.

George Hammond, president, NTN Bearing Corp.
Contribution: $20,000 grant

"It's truly a pleasure for Schneeberger to play a significant role in the engineering awards program. We welcome the opportunity to do our part to promote the engineering discipline," says George Jaffe, executive VP at Schneeberger Inc. "As we move towards the millennium, the pressure to remain technologically competitive will increase. I congratulate *Design News* on the success of this program that not only effectively publicizes the importance of the engineering profession, but also provides much-needed funds for our engineering institutions."

The MacNeal-Schwendler Corp. will support three $5,000 technology prizes for the

Tom Curry, president,
The MacNeal-Schwendler Corp.
Contribution: $15,000

Grand Prize winners of the Excellence in Design contest, now in its nineteenth year. Last year's recipients include Thomas Zimmerman, designer of Personal Area Network (PAN) devices which use capacitive coupling to allow humans and machines to exchange digital information through touch; Geoffrey Ball's Floating Mass Transducer technology for the hearing impaired, which by-passes the eardrum, simulating the middle ear instead; and M. Steven Rodgers, senior technical staff member at Sandia National Laboratories, for his work on the 24-bit Stronglink—a micro electromechanical system for safeguarding next-generation weapons.

"The predominant role of engineering in the design process has been rapidly changing in the past several years. Engineering is more and more being used to predict performance rather than only validate or fix a design late in the process," says Tom Curry, president and CEO at The MacNeal-Schwendler Corp. "The Excellence in Design Award winners have realized the value of engineering in new product designs. We are proud to be a part of this *Design News* program."

Design News will present four second-place winners in the 1999 Excellence in Design competition with an Acoustic Wave stereo system manufactured by Bose Corp. Finally, Edmund Scientific Co. (New York, NY) has donated four Astroscan telescope packages to be given to the third-place winners in the design contest.

George Jaffe, executive vice president, Schneeberger Inc.
Contribution: $20,000 grant

Most awards will be presented at the *Design News* Engineering Awards Banquet on March 16, 1999, at the Ritz-Carlton. This event is held in conjunction with the National Design Engineering Show at National Manufacturing Week.

"*Design News* is proud to recognize the engineering innovations that contribute to the advancement of technology in such fields as automotive, aerospace, medical, and consumer markets," says *Design News* Publisher Larry Maloney. "The strong support of our sponsor companies helps insure that tomorrow's engineers will meet the challenge." **dn**

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Circle No. 198

Pressure reduction ups efficiency

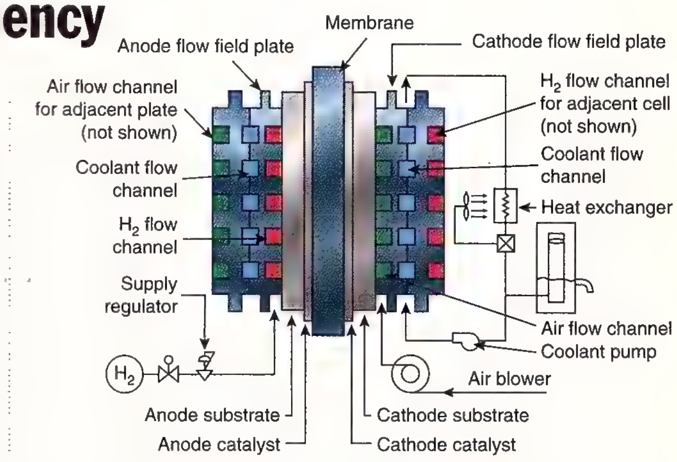
South Windsor, CT—In order to achieve adequate efficiencies, the oxygen in PEM fuel cells is typically fed under pressure. Creating that pressure takes a compressor, and compressors consume energy, reducing efficiency of the overall fuel cell.

Engineers at Int'l Fuel Cells (IFC) in South Windsor, CT, believe they have developed a way to eliminate the compressor while maintaining efficiency. "We can run ours at ambient or nearly ambient pressure," says Alfred Meyer, the company's director of engineering.

The secret lies in a patented method of "passive water management" that lets IFC create optimum conditions for the electrodes and achieve a level of performance at ambient pressure equivalent to what others achieve with pressurized systems, says Meyer.

PEM fuel cells require that the hydrogen electrode (anode) have a source of water to keep it wet and enhance its performance. Water is also created at the air electrode (cathode) as a product of the reaction. Because they are low-temperature devices, PEM cells produce their water in the liquid phase, and this water tends to film on the cathode, slowing diffusion of oxygen through the film.

The fuel-cell plates typically have a gas housing on either side of the electrode with ribs formed on it and slots in between through which gases pass into the cell. IFC makes these plates of porous graphite, which acts as a sponge to absorb water off the electrode. With the water out of the way, the air gains optimum access to the electrode and no compressor is needed to help improve diffusion.



Water management system for PEM fuel cells

Plates made from porous graphite help keep the electrodes dry in IFC's proprietary PEM fuel cell design. Note that individual cells can be easily combined back-to-back to form a fuel-cell stack.

The company has built cells running at 0.8 psi gauge using a blower instead of compressor. Meyer claims that for a 50 kW power plant delivered to Ford they achieved a total efficiency of 50%. When the power was reduced to 20% of maximum—approximately cruise output for the car—efficiency rose to 60%.

For more information on fuel cells from Int'l Fuel Cells (P):
Circle 540

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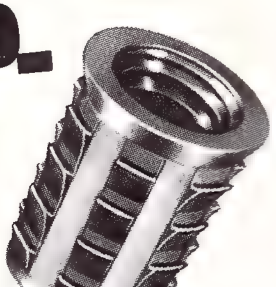

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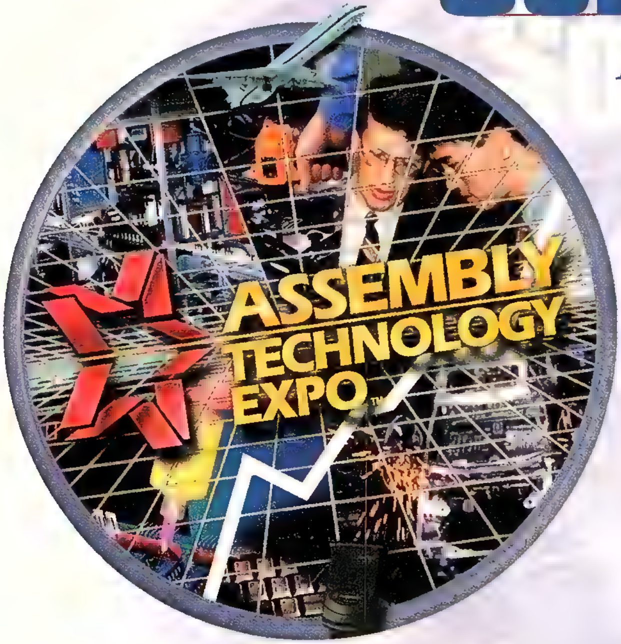

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Ford expands software use

D*earborn, MI*—As design engineers' skills improve with using computational fluid dynamics (CFD) software packages, use of the codes is becoming more widespread and gaining acceptance in many industries. Leading the way are automobile manufacturers, who use such programs to simulate gas and liquid flows in various systems, such as climate control, air intake, engine-cooling and radiator heat transfer, exhaust manifolds, as well as external and under-hood aerodynamics.

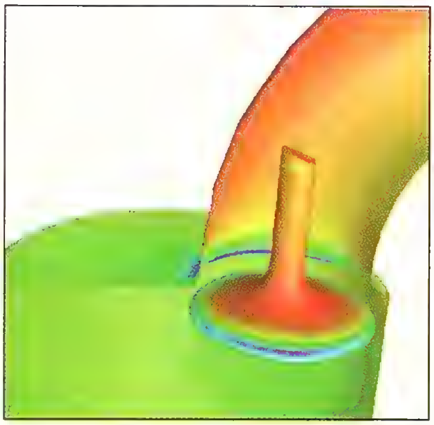
Time to market is critical in keeping a company's vehicles up to date in technology and down to earth in cost. Software packages drive down this time and cut design and prototyping expenses. Chris Greiner, a technical specialist at Ford's Advanced Vehicle Technology operation, says modern codes are critical. "We have a suite of solver tools, this way the company has the right one for a given application," he adds. "We model many components as part of the effort to get away from physical prototyping and reduce the design cycle."

As part of this effort, Ford recently reached a license agreement to expand its use of CFD software from Fluent (Lebanon, NH). The FLUENT/UNS package is a general-purpose solver for many classes of problems, so it can be used for a variety of analyses. The software will be used by Ford and its divisions in the U.S. and Europe, such as Visteon, a manufacturer of radiators, heat exchangers, and flow ducting, and luxury-car maker Jaguar.

According to Fluent president and CEO, Bharatan Patel, the automotive industry represents about 12% of Fluent's worldwide business and is still a significant growth market. The company recently opened a new Detroit-area office staffed with automotive CFD engineers to provide technical support, training, and consulting to the industry, in addition to sales. **dn**

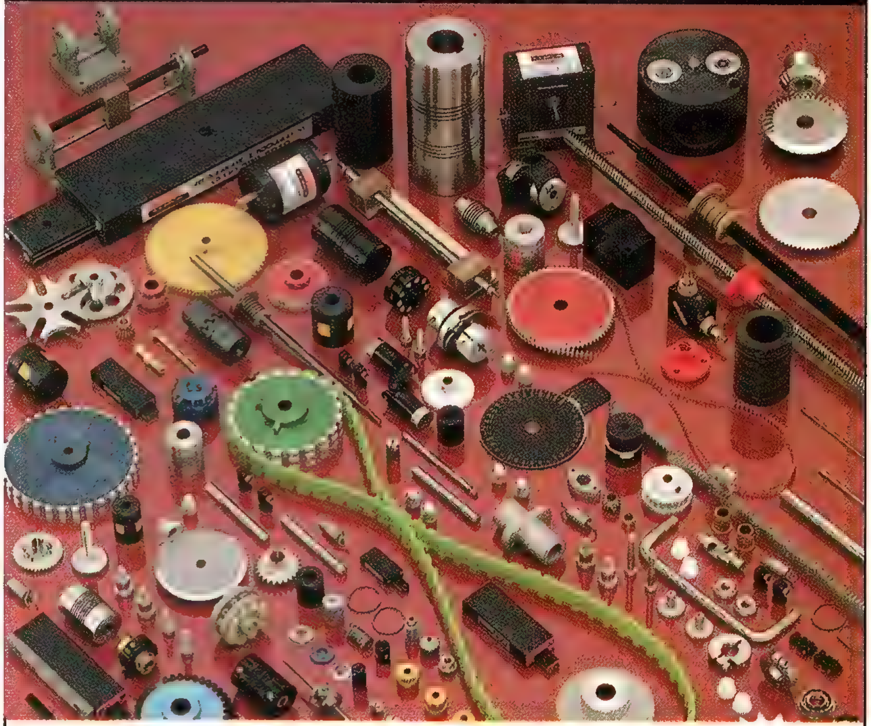
—Rick DeMeis,
Associate Editor

For more information on CFD software from Fluent (C):
Circle 541



Intake-valve flow bench tests at different 'valve lifts' can be CFD-simulated. This FLUENT/UNS representation reveals pressure as air flows over the valve: Red is highest, purple lowest as air accelerates over the edges.

Can you find the part you need in this picture?



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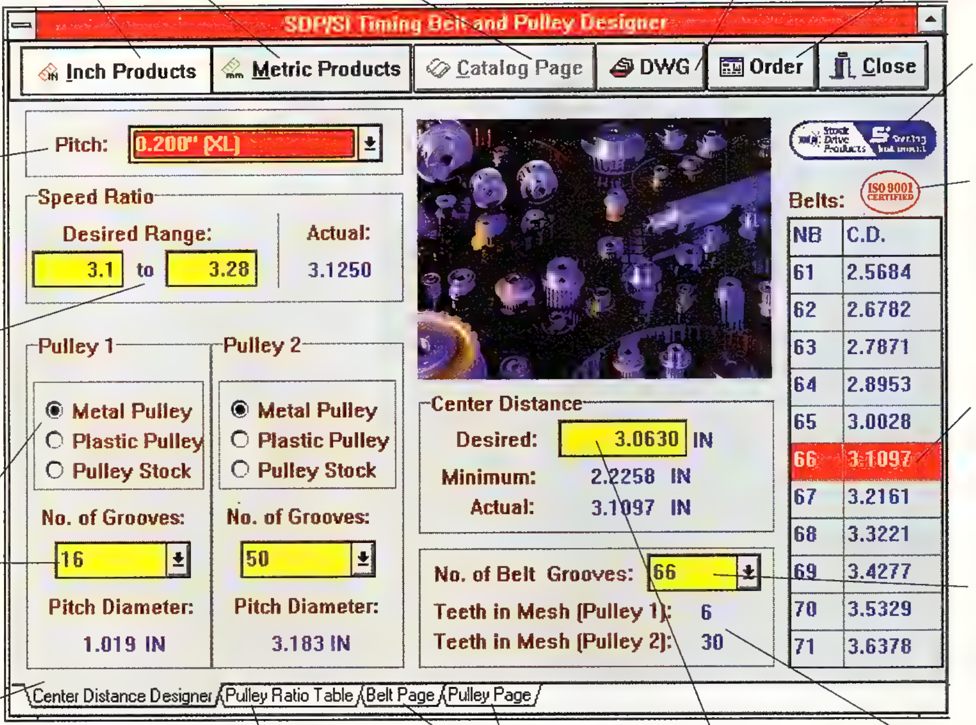
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Pitch: 0.200" (XL)

Speed Ratio
Desired Range: 3.1 to 3.28
Actual: 3.1250

Pulley 1
● Metal Pulley
○ Plastic Pulley
○ Pulley Stock
No. of Grooves: 16
Pitch Diameter: 1.019 IN

Pulley 2
● Metal Pulley
○ Plastic Pulley
○ Pulley Stock
No. of Grooves: 50
Pitch Diameter: 3.183 IN

Center Distance
Desired: 3.0630 IN
Minimum: 2.2258 IN
Actual: 3.1097 IN

No. of Belt Grooves: 66
Teeth in Mesh (Pulley 1): 6
Teeth in Mesh (Pulley 2): 30

Belts:

NB	C.D.
61	2.5684
62	2.6782
63	2.7871
64	2.8953
65	3.0028
66	3.1097
67	3.2161
68	3.3221
69	3.4277
70	3.5329
71	3.6378

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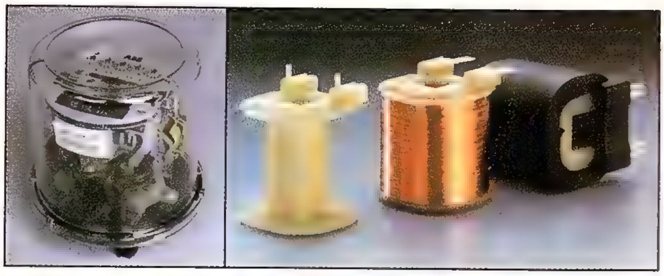


Nylon bobbin for voltage coil features a design that aids automated winding and termination, cutting production costs.

Nylon coil survives lightning-like surges

Raleigh, NC—A milestone in the high-voltage performance of thermoplastic-encapsulated coil devices. That's how ABB Electric Metering and Control describes the new coils used in its single-phase and polyphase electromechanical watt-hour meters for residential and commercial applications. The new version replaces an older design overmolded with thermoset epoxy.

ABB puts the new coils through 8 kV tests twice, using a specific wave form that simulates a powerful lightning surge. Not only do the coils pass, but they achieve this high-voltage performance at a cost savings. ABB engineers attribute this to the use of Zytel® nylon resin supplied by DuPont Engineering Polymers (Wilmington, DE), astute component design, and a shift to an automated manufacturing and assembly operation.

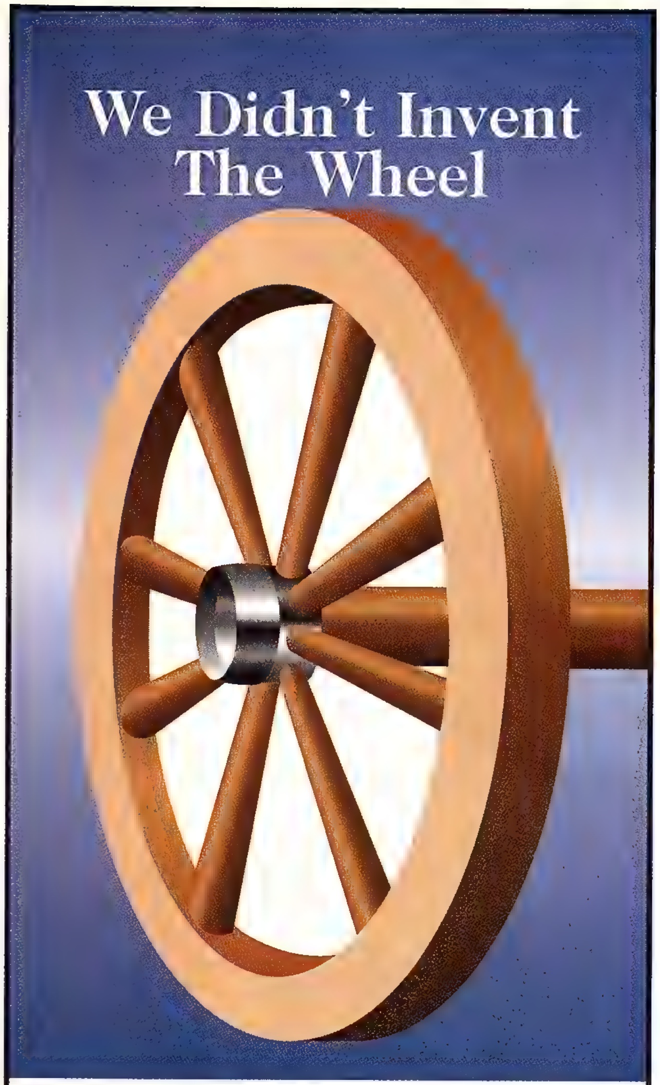
"We took advantage of the toughness, strength, and high-productivity molding characteristics of Zytel nylon in designing the coil bobbin with automated winding, termination, and encapsulation in mind," explains ABB Project Engineer Russell Broome. The grade used: Zytel 70G33HS11, a heat-stabilized nylon 66 resin with 33% glass-fiber reinforcement.

When the coils are wound, the winding machine ties off lead wires to temporary posts molded as part of the bobbin's terminal area. The posts shear off during automated insertion of insulation displacement (ID) terminals into pockets provided in the bobbin for just that purpose.

The grade of nylon used for encapsulation is the same as that of the bobbin. On the recommendation of DuPont engineers, the ABB team designed the bobbin with a groove on each flange in the area where the encapsulation material must seal to it. That area has a groove with a reverse taper. During encapsulation, material flows into the reverse-tapered groove, causing the thinnest tapered areas of the bobbin to soften and bond with the encapsulation material. This arrangement provides more output with less labor than the thermoset molding process used in the past, according to Broome. In addition, the change from thermoset molding powder to pelletized nylon eliminates airborne dust, while the hot-runner mold does away with runner scrap. **dn**

For more information on Zytel nylon 66 from DuPont Engineering Polymers (M):
Circle 542

News continued on page 77



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Bimba Flow Controls, available in four models, regulate cylinder speed. Circle No. 208

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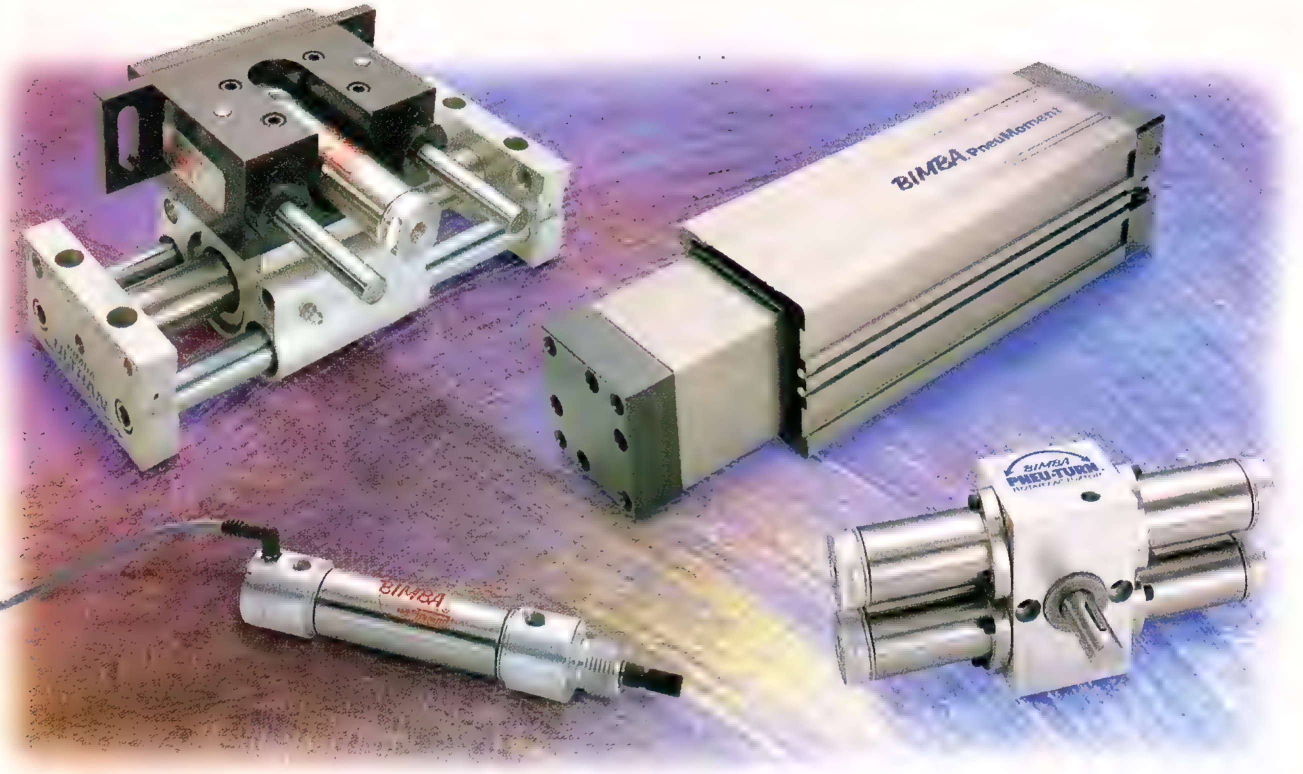
forget our quality.



Bimba ISO Cylinders are ready for delivery, competitively priced and are specifically designed to meet international standards for dimensional interchangeability. A new Position Feedback Cylinder that meets ISO 6431/VDMA 24562 standards is also available. Circle No. 209

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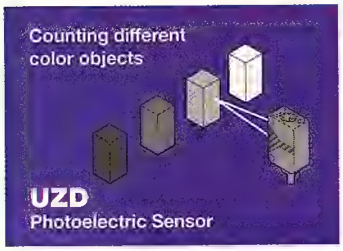
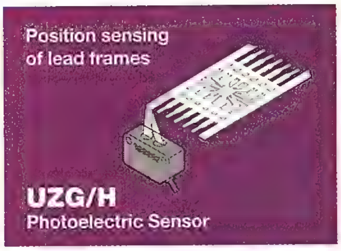
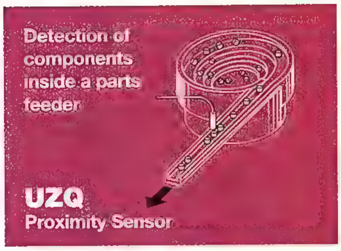
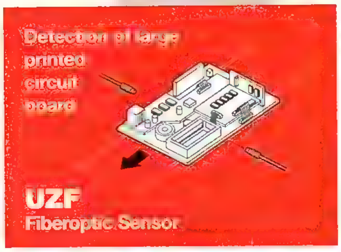
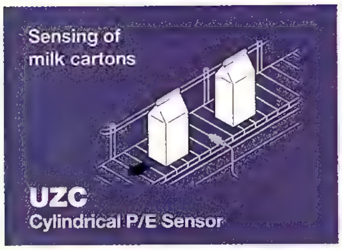
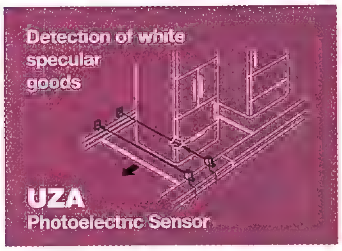


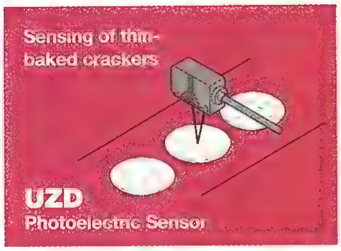

Position sensing of lead frames
UZG/H
Photoelectric Sensor

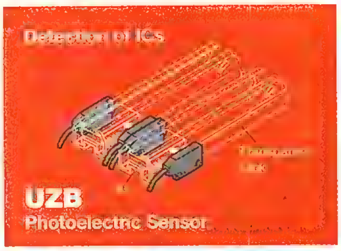

Detection of components inside a parts feeder
UZQ
Proximity Sensor

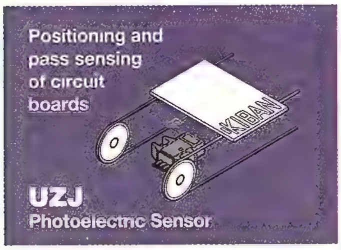

Detection of large printed circuit board
UZF
Fiberoptic Sensor



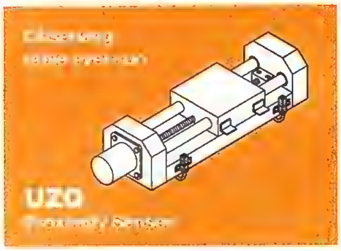

Detection of white specular goods
UZA
Photoelectric Sensor

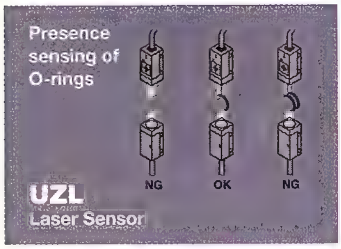


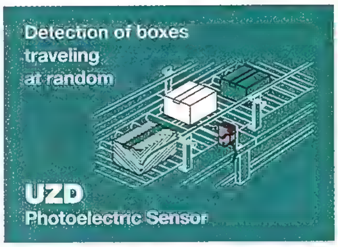


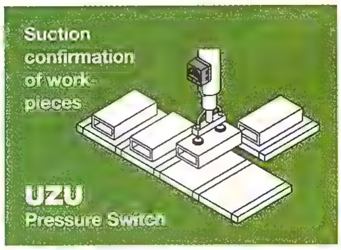

Positioning and pass sensing of circuit boards
KIBAN
UZJ
Photoelectric Sensor

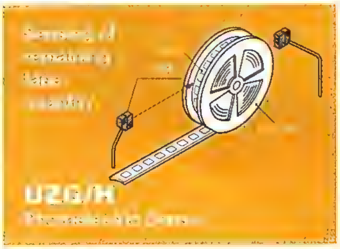
Application problems? Aromat solutions!

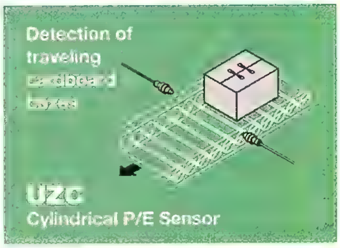


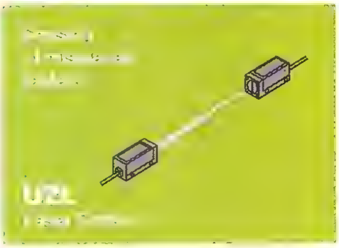



Detection of boxes traveling at random
UZD
Photoelectric Sensor






Detection of traveling cardboard boxes
UZC
Cylindrical P/E Sensor



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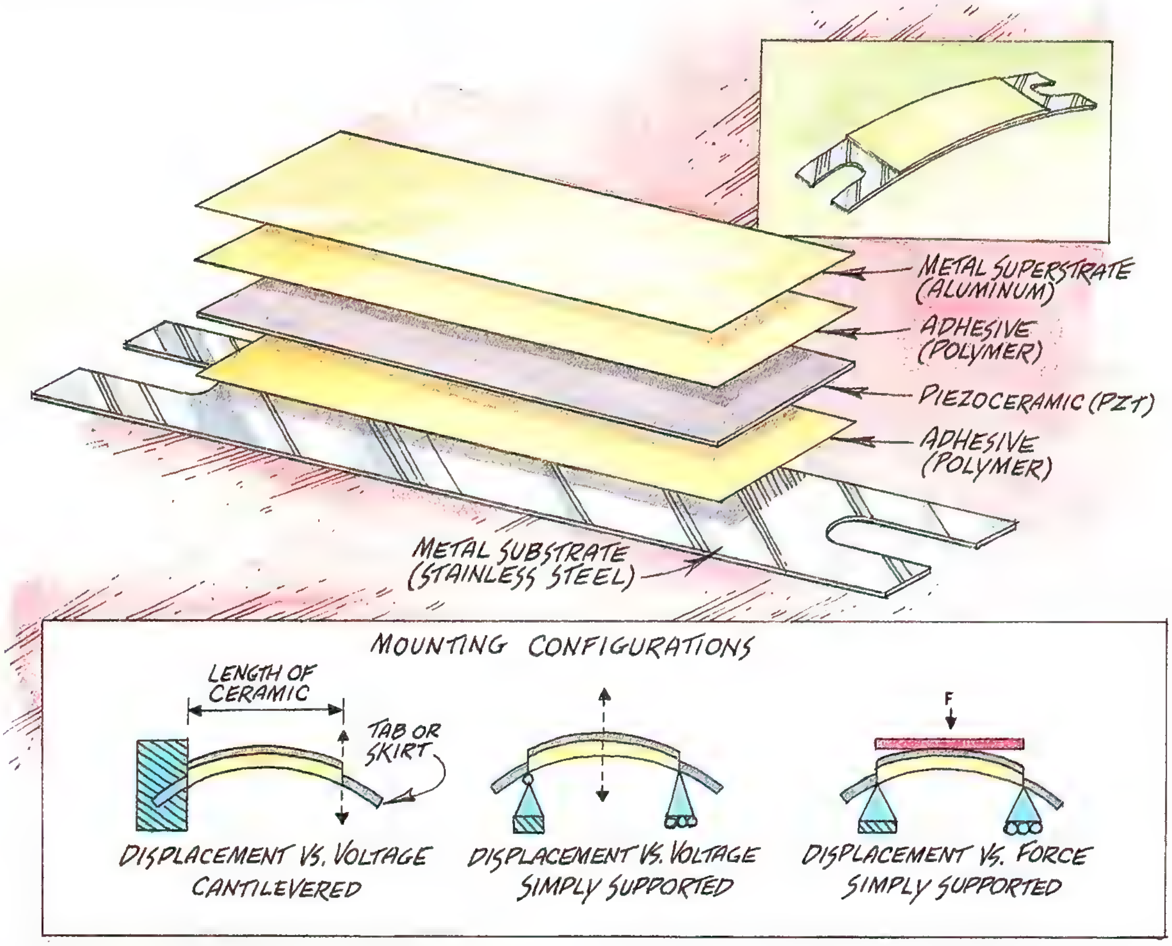
The low-cost, high-displacement actuator or sensor design is robust, reliable, and offers low power consumption and efficient energy conversion. Devices come in a wide variety of shapes and sizes—disks, squares, and strips—from a few millimeters to many centimeters in size.

Various mounting and multiplexed configurations, such as nested or clamshell stacks, offer flexibility to customize displacement or force to specific applications such as motors, pumps, or valves. **Norvell Rose, Race Intl. Corp.**, (P) 427 West 35th St., Norfolk, VA 23508; (757) 624-2121.

For information, circle 509


METAL SUPERSTRATE (ALUMINUM)
ADHESIVE (POLYMER)
PIEZOCERAMIC (PZT)
ADHESIVE (POLYMER)
METAL SUBSTRATE (STAINLESS STEEL)
MOUNTING CONFIGURATIONS
LENGTH OF CERAMIC
TAB OR SKIRT
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DISPLACEMENT VS. VOLTAGE CANTILEVERED
DISPLACEMENT VS. VOLTAGE SIMPLY SUPPORTED
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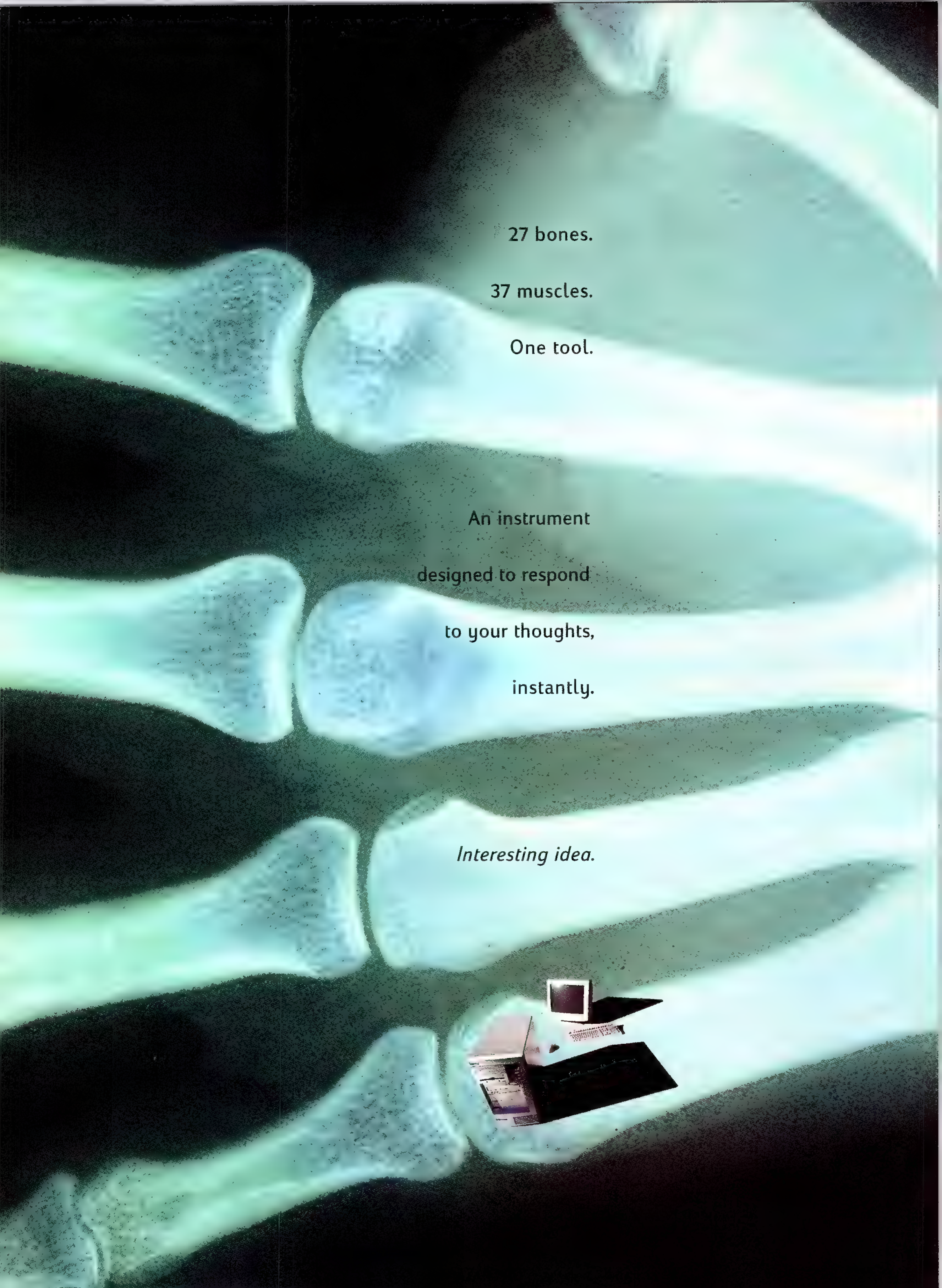
Metallic layers, adhered to each side of the pre-stressed piezoceramic element, protect it from potential damage. The composite design withstands higher voltages, and results in increased force and displacement.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Frank Jin, Rimtec Corp., (A) 825 N. Cass Ave., Suite 305, Westmont, IL 60559; (630) 325-7432.
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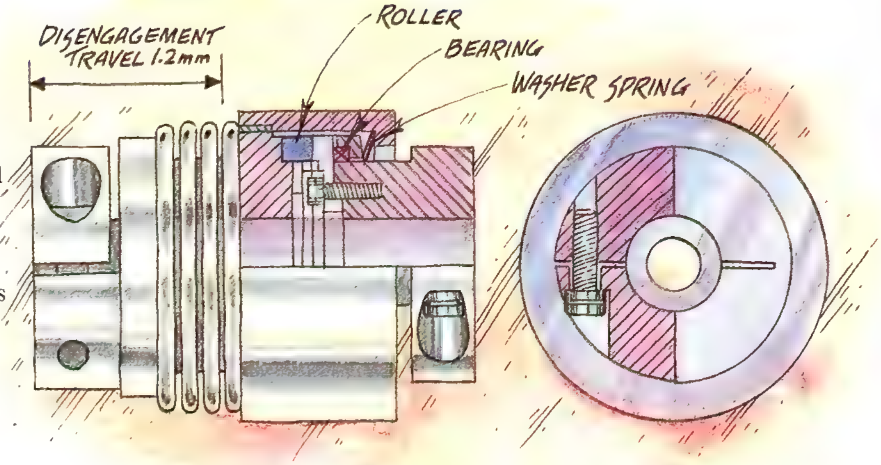


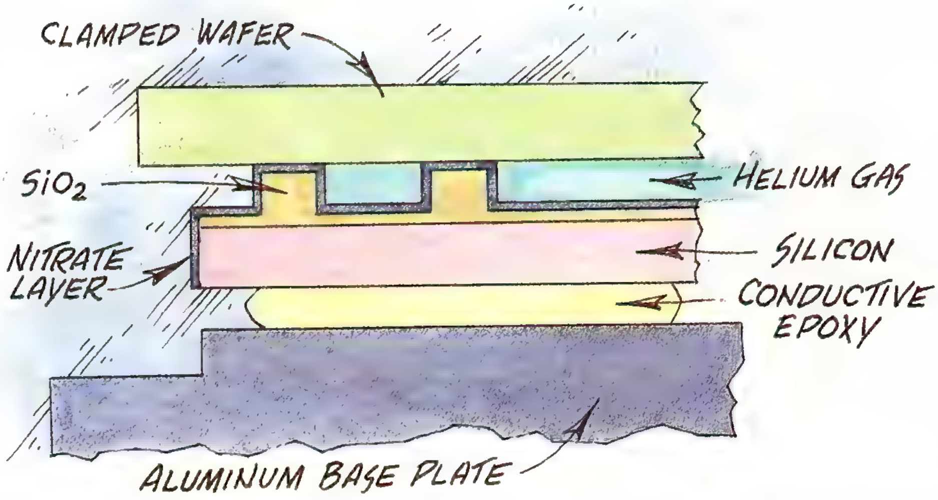
Pre-stressed Bellville spring disengages safety coupling within 4 msec to prevent costly machine and drive damage on high-production transfer lines.

Cool tool

Electrostatic chucks support and help cool silicon wafers during manufacturing. Conventional types use expensive, dielectric materials in the chuck's face that can introduce contaminants. Moreover, mechanical damage may result if the static-holding charge takes too long to discharge, as is often the case.

To lower costs, decrease cycle time, and generate less scrap, a new chuck face made of an easily produced, patterned silicon wafer, uses tiny, non-conductive silicon dioxide islands on its surface. These micromachined, non-conductive raised areas on the chuck face prevent excessive currents when the strong electric field is applied between the chuck face and the clamped wafer. Result: fast on/off cycling for quicker de-chucking.
Carl Seager, Sandia National Laboratories, (E) Albuquerque, NM 87185; (505) 844-9168.
For information, circle 511

Using the same materials as computer chips—silicon, silicon dioxide, and silicon nitride—this new electrostatic chuck design should result in lower manufacturing costs and fewer batch contaminations.



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Circle No. 217

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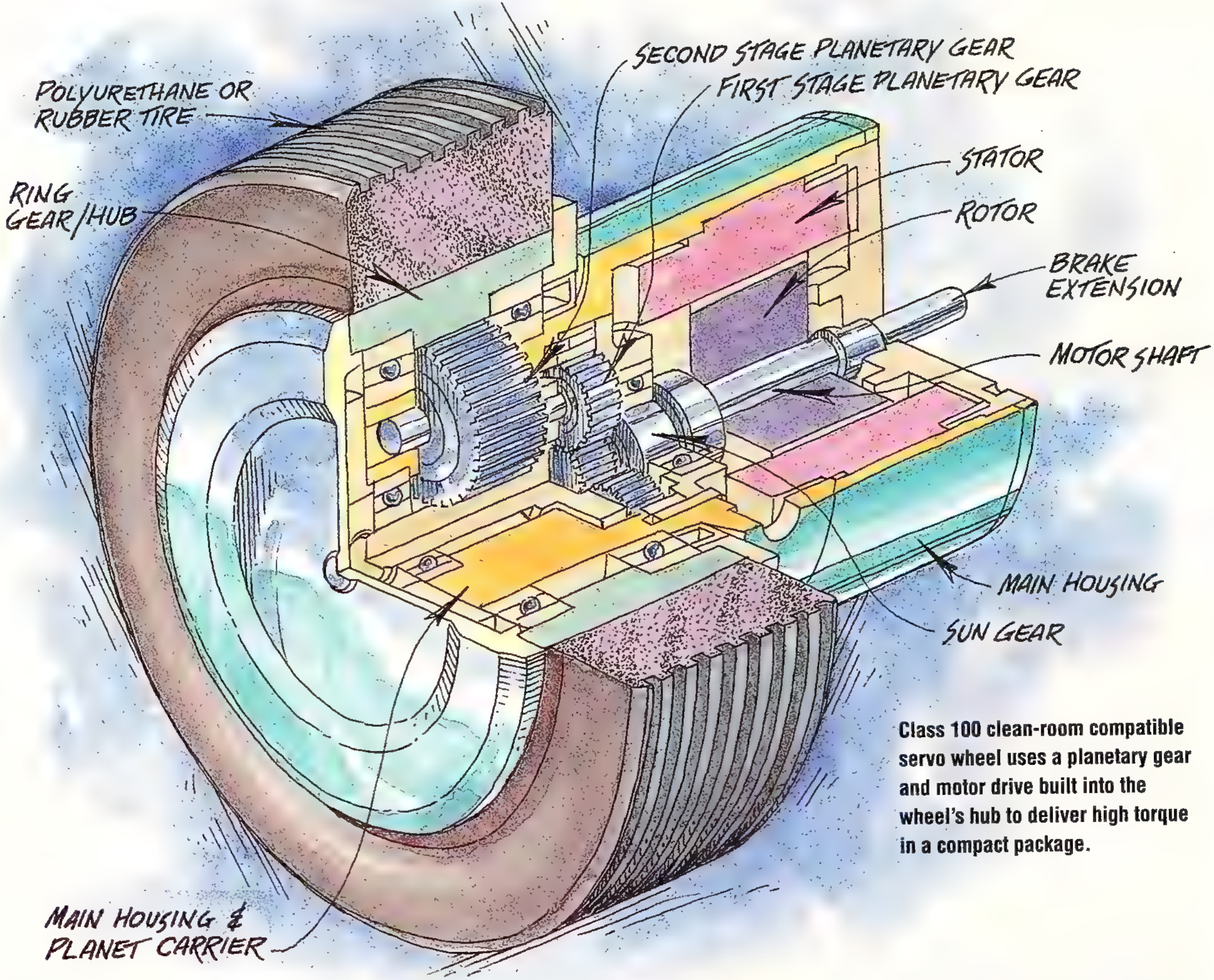
Planetary gear reduction delivers high torque capacity in a compact design that is lubricated for the system's life to reduce maintenance. Low electromagnetic interference eliminates the need for heavy shielding, and built-in position sensing eliminates the need for an encoder or tachometer.

John Deverdits, Rockland Servo Wheels, (P) 27 Seaview Blvd., Port Washington, NY 11050; (516) 484-5482 x140.

For information, circle 512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ROTOR
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MOTOR SHAFT
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SUN GEAR
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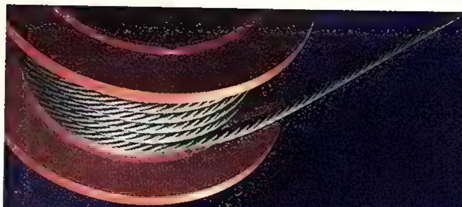
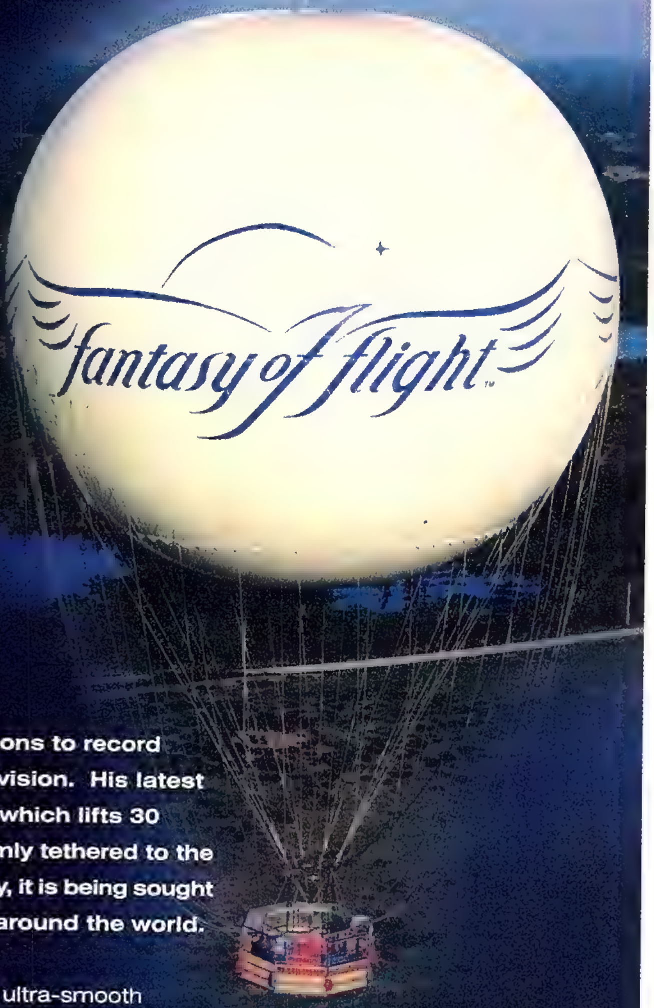
Class 100 clean-room compatible servo wheel uses a planetary gear and motor drive built into the wheel's hub to deliver high torque in a compact package.

Submit your ideas and rough drawings for this section to John Lewis, Designer's Corner, Design News, *275 Washington St., Newton, MA 02158*

Did you find this article useful?
If so, let us know. Circle No. 521





Vision

As well as manufacturing and piloting balloons to record breaking limits, Per Lindstrand is a man of vision. His latest product, 'HiFlyer', is a helium filled balloon which lifts 30 passengers to a height of 500 feet whilst firmly tethered to the ground. Not surprisingly, it is being sought after by theme parks around the world.

The project called for an ultra-smooth computer controlled winch capable of paying out and retrieving the balloon safely and quietly. Naturally, he turned to David Brown, one of the world's truly great names in specialized engineering, to develop a total turnkey package including the geared winch, cables, shackles, control systems and software.

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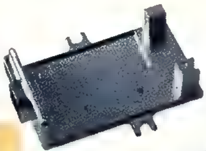
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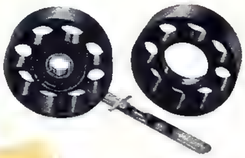
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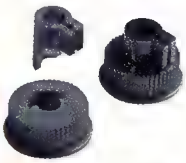

This two-piece, sinter-bonded stainless steel timing belt pulley is used in a high-speed printer. It won an MPIF Part-of-the-Year Grand Prize.

This 71-tooth, 26 DP gear and two-piece sinter-bonded cam are compacted to net shapes and require no secondary machining.

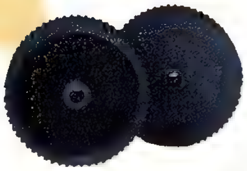
This P/M main bearing is produced in three versions, depending on hub length, and is used in a variety of rotary refrigeration compressors.

This compound epicyclic planetary gear drive contains eight P/M parts in five different configurations. '92 MPIF Ferrous Grand Prize.

This five-level, nickel-steel inter-axle differential case won the Grand Prize in an international P/M Part-of-the-Year design competition.

This brake actuator has four P/M components, along with interchange-able left-hand rotors and stators. '93 MPIF Ferrous Award of Distinction.

We developed a proprietary iron-copper P/M alloy to replace bronze for these gear pump thrust plates.


This integral rotor/flywheel gear is used in high-speed, mechanical printers. '95 MPIF Ferrous Award of Distinction.

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Circle No. 219

Sneaker sensors keep marathon runners on track

Boston—Sensors attached to runners' sneakers, used in conjunction with RF technology, helped armchair enthusiasts and print media track runners of this year's Boston Marathon.

This system is the next step in the progression of technology used to track the marathon. In 1996, mats and sensors were only at the start and finish of the race. In 1997, the mats were at the beginning, halfway, and end of the race, but were only used to time and score the race.

The sensor system, used for the first time extensively for the Boston Marathon, was used in addition to existing tracking systems, and used radio frequency (RF) technology. Runners, with chips tied to their sneakers, ran over 25-ft-wide mats at 11 points throughout the marathon, the first being at the 5-km mark. The mats featured an antenna field on the outside that was generated by three smaller antennas on the inside parts of the mat.

As the chip on the runner's sneaker came into contact with the RF parabola, the parabola charged the chip, says Phil Graceffa, technology coordinator for the Boston Athletic Assoc.

The inner antennas on the mats read and picked up the unique code on each chip, which was collected on a laptop at each location. The laptops were tied into a Windows NT server, located remotely at the Boston Athletic Association's computer room at the Copley Plaza Hotel in Boston.

All the data was fed into a database, sorted and spit out, then copied onto the Boston Marathon web site, www.bostonmarathon.org, using a T1 link provided by Digital Equipment Corp. (Maynard, MA), Graceffa adds. Digital worked with Microsoft to develop the server based on Windows NT, and also provided all the interfacing equipment, desktop PCs, and notebook computers.

On race day, the web site recorded 1.9 million hits, double last year's total, according to Jack Fleming, spokesperson for the race. He attributes the higher traffic to a general increase in access to the Internet, plus more publicity for the site.

This sensor, tied to Boston Marathon runners' shoes, transmitted information about runners via mats on the ground across the race route to the official marathon web site during the race.

The sensor technology allowed all runners to be put on the web site. It also helped from a psychological point of view. In essence, the clock did not start until the runner crossed the start line. "It's very forgiving," Fleming says. "It gives runners in the back a sense of not being penalized."

The sensor system also helped make sure runners stayed the course. "If they don't show up at a couple of consecutive checkpoints, you'd have to look a little deeper to see if something happened with their particular chip, extenuating circumstances, or maybe they cheated," Fleming adds.

The sensor system's main use, Fleming says, is as the primary method for timing and scoring the race, a more passive scoring method than previous ones.

At the finish, runners used to hand numbered popsicle sticks or index cards to race officials. Next came tear-off tags with barcodes read by scanners. "Now, it's completely passive, where the runner just crosses the finish line and it's all electronic," Fleming adds.

The catalyst for the sensor technology project was Digital, working with the Boston Athletic Association, Fleming says. "They wanted us to do something that was cutting edge, and they provided us the resources to do this," he adds. "They spearheaded the cooperation and coordination to get this done."

***For more information about computer technology from Digital Equipment Corp. (C):* Circle 543**

Choosing the Right Seal

Dalia Vernikovsky
Worldwide Market/
Sales Manager
Greene, Tweed & Co.

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Ultrapure Deionized Water Systems (UPDI) present significant challenges to the seal designer. The ozone used to kill bacteria in most UPDI systems will also destroy most standard O-ring compounds. Deterioration introduces massive amounts of the metallic contaminants in O-rings. Peroxide and hot deionized water (83°C) also degrade standard elastomers, as does the UV light added at various exposures to break up organics.

This degradation is clearly unacceptable in systems that demand extremely stringent PPB (parts per billion) and PPT (parts per trillion) levels of particulation. TOC's (total organic carbons) are the most problematic contaminants, since they can adhere to wafers and result in degraded oxide quality and hazy films. Cations (metallic elements) and anions (fluorides, chlorides, sulfates and iodides) also cause significant production problems.

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On the cutting edge

The MACH3 razor employs a design that borrows from its predecessors

CHRISTINE M. FERRARA, NEW PRODUCTS EDITOR

Just like two heads are better than one, The Gillette Co. (Boston, MA) is betting that three blades on your razor are better than two.

The MACH3™ razor from Gillette, which hits stores this month, features three blades in a progressive configuration for "a better way to shave," according to Thomas Gallerani, vice president of the shaving technology laboratory at Gillette.

The shaver evolved from a number of design approaches over a 20-year period, most notably the SensorExcel™ and other predecessors. After Gillette launched the first twin blade, Trac II®, in 1971, the thought was, "If two blades are good, why not three?" Gallerani adds.

The first prototypes of the three-blade approach in the 1970s meant an uncomfortable shave, with excessive pull and nicks. However, the MACH3's difference is that it evolved from older, established razors like the Sensor, Atra Plus, and Trac II and brought their existing technologies together in a whole new way, Gallerani says.

MACH3 features an ergonomically designed handle, and fits into a carrying case. The razor takes replacement cartridges, which are sold separately.

Gillette engineers prototyped and tested the razor, then converted it from prototype using Unigraphics CAD software from Unigraphics Solutions. Gillette then consumer-tested the product on men, who found the razor reduced the need to reshave because of the progressive alignment and diamond-like coating of the blades. The razor also removes 40% more hair than a two-blade system. The need to reshave is the biggest problem for the majority of men. dn

For more information

For more information on the MACH3 razor from Gillette and some of the tools and materials used to create it, circle the numbers below.

Noryl™ polystyrene from General Electric Plastics (M): **Circle 501**

Unigraphics CAD software from Unigraphics Solutions (C): **Circle 502**

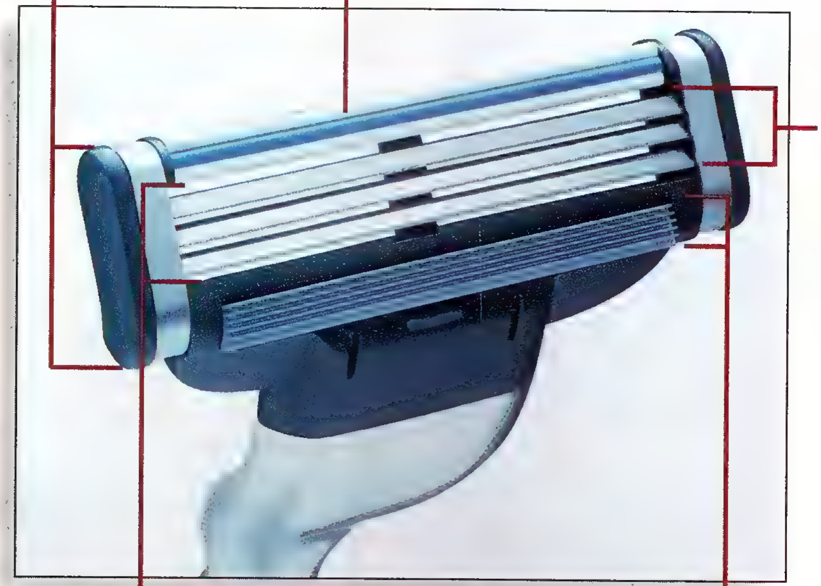
Did you find this article useful? If so, let us know. Circle No. 523

Cartridge

MACH3's cartridge is a plastic-molded component made from Noryl™, a proprietary blend of polystyrene and polyphenylene oxide. The cartridge features an open architecture to allow debris, such as hair and soap, that might otherwise clog the head, to flow freely through it. A forward pivot is built into the cartridge rather than the blade handle, which allows the three blades to stay in progressive alignment as they move across the face.

Indicator™ lubricating strip

The lubricating strip at the razor's top is composed of polystyrene and polyethylene oxide (PEO), which are blended and co-extruded, and aloe and vitamin E. The strip delivers PEO lubricant during the shave, dissolving and wearing with use to let the user know when shaving quality is no longer at its highest. Gillette tested the strip on men, and calculated the average rate of wear to determine when the blue stripe would dissolve.



DLC™ comfort edges

The blades' DLC coating is a non-metallic, semiconductor-like deposit of carbon, which has been converted to a diamond-like, non-crystalline material. The material is two to three times harder than steel, and is applied in an 800-angstrom-thick layer.

Blades

MACH3's cutting edges are positioned in a progressive configuration and made from stain-resistant carbon steel, which Gillette buys directly from suppliers in Japan, Sweden, and England. The blades are about 10% thinner than Gillette's regular blades, their thinnest yet, and are the first major blade innovation in this category since the 1960s, the company says. The blades are independently spring-mounted, like the predecessor MACH3 borrows much of its technology from, the SensorExcel™.

Microfins

The razor's microfins on the cartridge's guard element help urge hair out of follicles and provide a masking sensation to the shaving process, which, Gillette's laboratories found through research, contributes to overall shaving satisfaction.

MACH3 vs. SensorExcel

Here's a look at the new razor, as compared to its predecessor, the SensorExcel:

	MACH3	**SensorExcel**
Dimensions:	5¼ inches long (cartridge to end of handle) 1½ inches wide, ½ inch long (cartridge)	5 inches long (cartridge to end of handle) 1½ inches wide, ¼ inch long (cartridge)
Blades:	Three, individually spring-mounted	Two, individually spring-mounted
Microfins:	Yes	Yes
Lubricating strip:	Indicator™ with Vitamin E and aloe	Lubrastrip® with water-activated moisturizers
Handle:	Ergonomically shaped metal, with three rubberized, crescent-shaped grips	Flexgrip™ handle with soft grips
Cartridge:	Open-architecture cartridge with pivot built in and single-cartridge docking	Open-back, flow-through cartridge
Cost:	$6.49-$6.69 (razor) $6.79 (four-pack of cartridges)	$4.49 (razor) $5.29 (five-pack of cartridges)

WANTED: Winning Designs

design news

1998 EXCELLENCE IN DESIGN COMPETITION

Join the ranks of the nation's most prominent engineers. Submit an out-of-this-world engineering design from the past year to the *Design News* Excellence in Design Competition. Fill out the entry blank on the back of the following page with details of your work and its impact on the engineering world. The top three contenders will be honored at the Annual Engineering Awards Banquet in Chicago on March 16, 1999, where each will receive a $5,000 Technology award from The MacNeal-Schwendler Corp.! Ten other engineers also will receive valuable prizes. This is the 19th year for the contest, the most prestigious in the profession. Don't miss this opportunity to stand among America's brightest engineers—enter now!

Grand Prize

The chosen three finalists will travel to Chicago, along with their spouses, where they will receive the Excellence in Design medallion at a special awards banquet on March 16, 1999 at the Ritz Carlton Hotel. Besides hotel and air fare, each winner will receive a $5,000 technology award courtesy of The MacNeal-Schwendler Corp.

MSC

Second Prize

Each of the three second-place winners will receive a Bose Lifestyle® 20 music system.

As an engineer, you have the power to create and design products that can change the world. These products can yield unimaginable results—many of which can be applied to other applications.

Think back to your projects over the past year—those which required many hours of dedication and persistence. Now is your chance to be recognized for this work. Enter it into the Excellence in Design Competition and you could be chosen as one of three top winners to each receive $5,000, courtesy of The MacNeal-Schwendler Corp. (MSC).

Each Grand Prize winner will be honored at the gala Engineering Awards Banquet, to be held in Chicago at the Ritz Carlton Hotel during the National Design Engineering Show, March 15-18. We'll provide transportation and a first-class hotel for you and your spouse. And, besides the cash prize, you will receive an engraved replica of the *Design News* story describing your winning design.

At the banquet, our "Excellence" winners will share the spotlight with the person voted by *Design News* readers as the Engineer of the Year. The winner of this award designates a college to receive a $25,000 grant sponsored by the Torrington Co. Another prominent engineer—the recipient of the *Design News* Special Achievement Award—designates a college to receive a $20,000 grant from NTN Bearing Corp.

Each of the three second-place winners in the Excellence in Design contest will receive a Bose Lifestyle® 20 Music System. The most technologically advanced system available from Bose, it consists of: Jewel Cube™ speakers; an Acoustimass® bass module; a six-disc CD changer, described by Bose as the world's smallest; an RF remote; and a brushed-aluminum music center that includes an AM/FM tuner with 30 presets plus inputs for Video 1, Video 2, Tape,

DEADLINE—SEPTEMBER 15, 1998!

Third Prize

Four entrants will receive an Edmund Scientific Astroscan telescope. Also included is a package of extras to complete the amateur astronomer's enjoyment: image erector, tripod, additional RKE eyepieces, and other accessories.

Quality Award

An Excellence in Design entrant who can demonstrate that his or her design led to major gains in product quality could designate an engineering school to receive a $20,000 grant, courtesy of Schneeberger Inc. This award also includes transportation and hotel for the Engineering Awards banquet.

SCHNEEBERGER
LINEAR TECHNOLOGY

and Auxiliary.

Four third-place winners in the competition will be awarded an Edmund Scientific Astroscan telescope set.

In addition, one of the entrants in our Excellence competition could be chosen as the tenth recipient of the Engineering Quality Award. The Quality winner chooses an engineering school to receive a $20,000 grant from Schneeberger Inc.

Contest rules. To enter, please submit a description of a design that offers such advantages as improved function, lower cost, longer life, reduced weight or size, or greater reliability. The design can be an improvement on an existing product—or an entirely new product or system. Answer all the questions on the form on the back of this page.

Use a separate piece of paper if necessary, and send along prints, drawings, photos, or other materials that support the design and help the judges fully understand the design problem and how you solved it.

Provide us with a clear and concise description of the problem, solution, and benefits of the final design. After judging takes place, *Design News* editors will contact the finalists to prepare stories on their designs for our March 1999 Design Show issue.

Judging criteria. Winning entries will exhibit cleverness of design, effective use of design components and materials, and usefulness and significance of the product.

Deadline for receipt of entries is September 15, 1998!

We presume submission indicates company clearance of the material and permission to use it in a *Design News* story. Entries by design teams are welcome, but teams must designate one member to receive the prize. Mail your completed entry form and supporting material to judges at:

Excellence in Design Competition, *Design News*, 275 Washington St., Newton, MA 02158-1630

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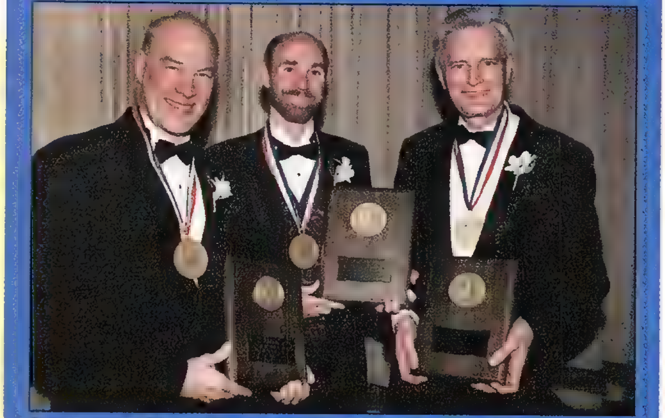


Excellence in Design winners shared the stage with Brian Muirhead of NASA's Jet Propulsion Lab (center), 1997 Design News Engineer of the Year for his work on the Mars Pathfinder; William "Red" Whittaker (left), winner of the Special Achievement Award; and Horst Maack, of Cincinnati Milacron, who received the Engineering Quality Award.

Excellence in Design winner Geoffrey Ball and his wife Sabina celebrated with engineers honored at the awards banquet held in Chicago at the Ritz Carlton. Ball's revolutionary Floating Mass Transducer bypasses the eardrum, stimulating the middle ear instead and as a result, improves the quality of hearing.

Tom Curry (left), President of The MacNeal-Schwendler Corp., presented a $5,000 award to Excellence in Design winner Thomas Zimmerman. His Personal Area Network Devicve (PAN) enables a person to serve as a conduit for the transfer of digital information between two electronic devices.

M. Steven Rodgers, Excellence in Design winner from Sandia National Laboratories, accepts his award from Paul Teague, *Design News* Editor-in-Chief. Rodgers' 24-bit Microelectromechanical Stronglink safeguards next-generation weapons.

DESIGN NEWS EXCELLENCE IN DESIGN COMPETITION

ENTRY FORM

1. Name of product, device, or system; how is it known (including trade name).

2. Company (or individual) responsible for design. Include complete name, address, and phone number.

3. When was the design completed? month/yr

4. When was it offered to the market? month/yr

5. Was this design previously described in any trade publication? no ☐ yes ☐ Publication and Date?

6. Is this idea patented? Patent No.

7. What was the design problem? What needed improvement or correction?

8. Describe the design solution to the problem.

(Include documentation such as blueprints, drawings, sketches, or photographs that show what was done. Judges may reject designs they do not understand because of inadequate descriptive accompaniment.)

9. How did this design benefit the manufacturer?

10. How did this design benefit the user or customer?

11. ☐ Check here if you would like to have your entry considered for the Engineering Quality Award. Please provide supporting documentation on how your design led to major gains in product quality.

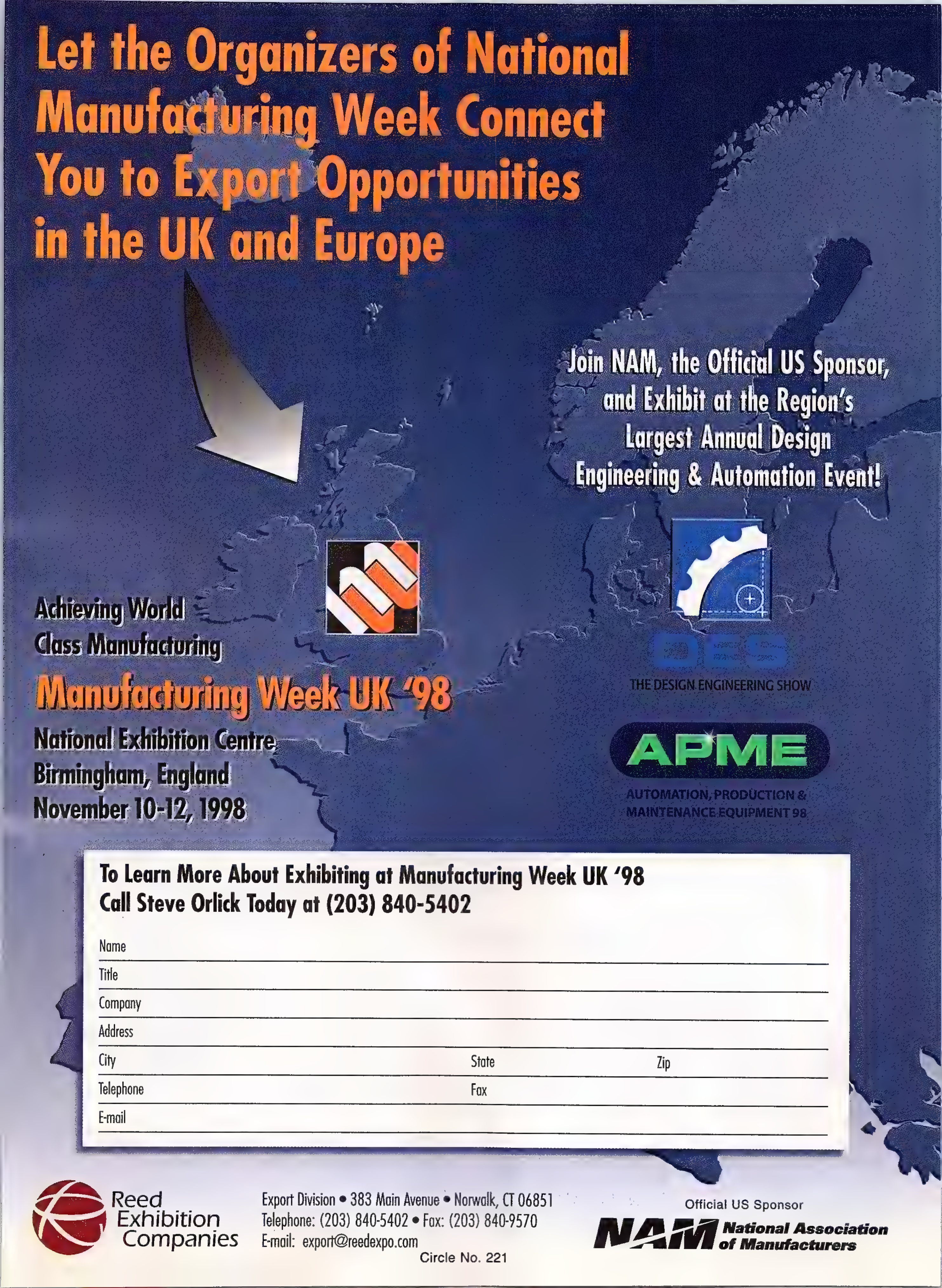
I was responsible for the design of the product described in my entry.

Submitted by: Name
Company
Address
Phone (for questions about entry) Is this a home phone?

Entries need not be sent on this form but the answers should follow this outline.

Catalogs, brochures, reports, papers, or operating instructions can be included if they help us understand what you did.

Mail to: Excellence in Design Competition, *Design News*, 275 Washington St., Newton, MA 02158-1630. Deadline: September 15, 1998.



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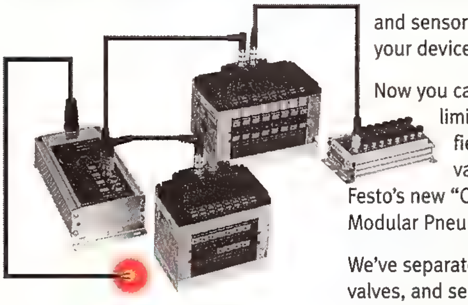

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Circle No. 222

Flared tube fitting stops hydraulic leakage

Maintains seal between beveled edge of fitting and flared tube

Charles J. Murray, Senior Regional Editor

Almont, MI—Hydraulic leakage: In most plants, it's an annoyance—a problem that draws attention but doesn't warrant immediate repair.

For those who judge the drip-drip-drip of a leaky fitting to be little more than an inconvenience, however, consider this: A fitting that leaks a drop per ten seconds loses about 40 gallons of hydraulic oil per year. A drop every second leaks 400 gallons per year. And a big assembly plant with 2,500 such fittings loses about 1 *million* gallons per year.

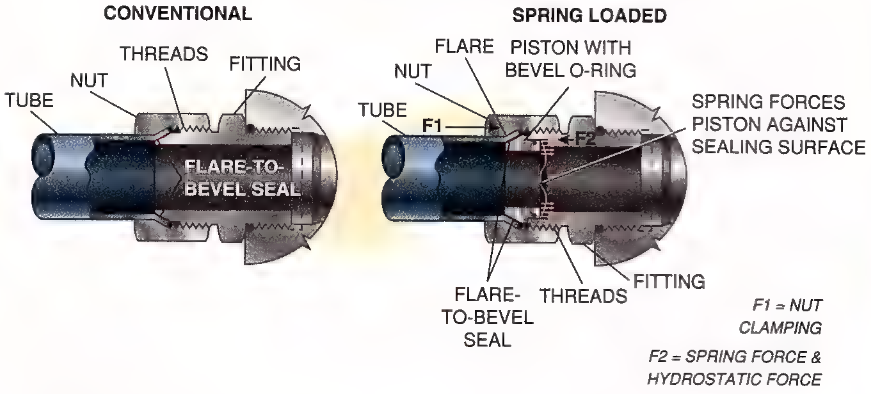
Fortunately, one engineer has devised a leak-free version of a particular type of connector: the flared tube fitting. Al Niemiec, a consulting engineer, developed a spring-loaded technique that addresses the leakage between the flared end of the tube and the beveled edge of the fitting.

Niemiec's solution solves a longstanding problem. In most such fittings, he says, the seal between the flare and the bevel leaks. The reasons for such leaks are numerous: expansion and contraction caused by thermal cycling, as well as pressure surges, line straightening, and cyclic loading. "Any of those things can create additional forces on the mating parts," Niemiec says. "And that relaxes the force engagement on the threads." Usually, he says, the relaxation of the force engagement is subtle—but it's enough to create a gap in the seal.

That's why Niemiec created the new flared tube fitting. It distinguishes itself through its use of a separate and independent piston with a beveled edge. The piston fits within the fitting but because it is independent, it doesn't necessarily move with it. As a result, when the nut backs off, the piston doesn't follow. Instead, it maintains contact with the flared tube.

To accomplish that, the piston works in conjunction with a spring. If the threaded nut backs off, the spring is allowed to expand. When it does, it forces the piston forward. As a result, the beveled edge of the piston never loses contact with the flare, and the seal is maintained.

FLARED TUBE SEALS: TWO APPROACHES



Conventional flared tube fittings employ a solid body. When the fitting engagement loses its pre-load, the seal between the flare and bevel can leak. The new design employs a small piston that moves independently from the rest of the fitting. If the fitting's pre-load relaxes, spring force pushes the piston's bevel against the flared tube, maintaining the seal.

Niemiec's patented design actually relies on two forces to maintain the seal. The user supplies the first force by pre-loading the spring during assembly of the fitting. The hydraulic system pressure supplies the second force. Since the piston is independent and free to move with respect to the rest of the fitting, it can take advantage of the hydrostatic force that bears against its back surface. As a result, Niemiec says his fitting can supply "several hundred pounds of sealing force" in a system operating at 1,000 psi.

Niemiec says that the design could help save thousands of gallons of hydraulic oil in large assembly plants, particularly those that employ injection molding machines. Such machines, he says, often use several hundreds of hydraulic fittings, many of which leak. "Once the manufacturer has started production, they are not going to shut down their machinery to take care of a small leak," he says. "Usually, they wait until a scheduled plant shutdown."

The new fitting could also help cut oil disposal costs. "The dripping oil usually gets flushed into a sump," Niemiec says. "And when the sludge from that sump has oil in it, it can be very costly to dispose of it."

Niemiec says that the new design could serve in many kinds of production machinery, and in automotive applications, such as brakes and power steering units. It is particularly well-suited for difficult-to-access applications, even in commercial plumbing, he says.

Thus far, the new design has been prototyped, but has not been produced in volume. Tests, however, have proven that the fitting applies continuous pressure between the bevel and flare. "No matter how much thermal expansion and contraction you have, the piston will always travel enough to maintain engagement of the seal," Niemiec says. **dn**

Additional details...Contact Al Niemiec, Box 551, Almont, MI 48003.

Other Applications

- *Hydrostatic fan drives*
- *Automotive power steering*
- *Injection molding machines*
- *Commercial plumbing*

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Like their counterparts in the U.S., Japanese design engineers rely on CAD. But, they emphasize design for manufacturing. Art courtesy of Autodesk.

Design

in the Land of the Rising Sun

In the U.S., engineers emphasize systems and use sophisticated software. In Japan, engineers concentrate on process and emphasize manufacturability. The two can learn a lot from each other

Design for manufacturing.

In the U.S., it's a practice that has emerged gradually over the last few years as companies have learned the hard way the follies of "over-the-wall" engineering communication: "Here, we designed it. You figure out how to make it."

In Japan, it's different. Design for manufacturing has been a way of life for a generation, a social value, part of the culture of cooperation and inclusion in this small, crowded, dynamic, and industrious country.

That's the consensus from interviews with engineers in several companies designing global products in and for Japan.

Design and manufacturing often work next to each other, where they develop design and manufacturing specs simultaneously, says Chris Miyazaki, manager of mechatronics for THK America. "Cross training and cross communications are critical in Japanese engineering," he says. "Most design takes place in cross-functional teams."

At Omron, design and production departments work together throughout the entire product-development process, says Yoichi Tomita, of the company's Industrial Business Group in Japan. The group develops Omron's industrial automation products, including PLCs, sensors, touchscreens, timers, counters, process controllers, power supplies, and machine vision products.

That kind of working relationship makes for an efficient product-development process. And make no mistake about it: Process efficiency is critical in Japanese companies, says Jim Rideout of NMB Corp., which produces 130 million bearings a month. "The secret to our business *is* process," he says. "The better the

Paul E. Teague, Chief Editor

NMB Corp. makes 130 million bearings a month worldwide. These miniature ball bearings are used in automotive applications, such as throttle bodies, ABS systems, and small electric motors. The process is the secret to their success, the company says.

process, the quieter the product."

And the lower the manufacturing costs.

A recent study by consulting firm D.H. Brown, Port Chester, NY, on agile product development notes that manufacturing costs are 8 to 10 times design costs. So, the Japanese encouragement of the use of manufacturing criteria in design can yield big benefits.

One example: The D.H. Brown study reports that in the spring of 1997, Japanese automakers decreased average engineering lead times (the time between approval of the exterior model design and the start of product shipment) to 20 months. The U.S. average: 30 months.

Part of the credit, the study says, goes to a system known as front-end loading: the acquisition of prior knowledge and the use of rapid problem-solving techniques that allow engineers to resolve issues earlier in the design cycle. Product information management and knowledge-based engineering software play a role here. So does the kind of cross-discipline cooperation and communication typical of Japanese companies.

As in the U.S., supplier involvement in design is important in Japan. THK America's Miyazaki says it's critical. "It's imperative that you get your supplier base to really listen to what you need," he says. THK actually has a financial stake in some of the company's first-tier suppliers, such as platers and extruders.

Japanese engineers also work very closely with customers, says Minoru Hayakawa, a design engineer at Amada. That was the case recently with a new punch press the company developed. While doing the design in Microcadam's Helix Modeling System, engineers worked closely with manufacturing counterparts, then travelled to the customer site to put it together and start it up.

That example leads to two other characteristics of Japanese design engineering: 1) Among the principal objectives is to meet market requirements, says Oriental Motors' Fred Otsuka; and 2) engineers stay with a project until it's finished.

"In Japan, design engineers follow each project through the completion of manufacturing," says

Made in Japan, AMP style

Sure there are differences in the way engineering is done in Japan and the U.S., but in the end, says Paul Youn, director of engineering for AMP's global PC business unit, it still all comes back to physics. "There is very little difference between how we conduct the design process in the U.S. and how we conduct it in Japan, says the Harrisburg, PA-based Youn.

Working from offices on the outskirts of Tokyo, AMP engineers design and develop connectors and interconnection devices for desktop PCs, mobile computers, peripherals, and other computer-related products. They work with customers such as IBM, Toshiba, Hitachi, and NEC to identify needs and components.

"Being close to the design centers of many customers permits us to leverage off the technical expertise of different engineers in different countries," says Youn. "Japanese engineers, for example, have outstanding skills in fine-pitch technologies."

Youn says the Japanese engineers have the same product-development schedule, the same review schedule, and the same testing procedures as engineers in the company's design centers in Singapore and the U.S.

And, like other engineers in the Land of the Rising Sun, they share information liberally. But they take that cooperation a giant step further: Quarterly, the Japanese and Singaporean design engineers go to the U.S. for engineering reviews where they exchange ideas and learn from each other.

—Karen Auguston Field,
Managing Editor

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When RKS Design, Inc. decided to expand their product design capabilities, the reasons to use CoCreate's product suite, including SolidDesigner, were loud and clear.

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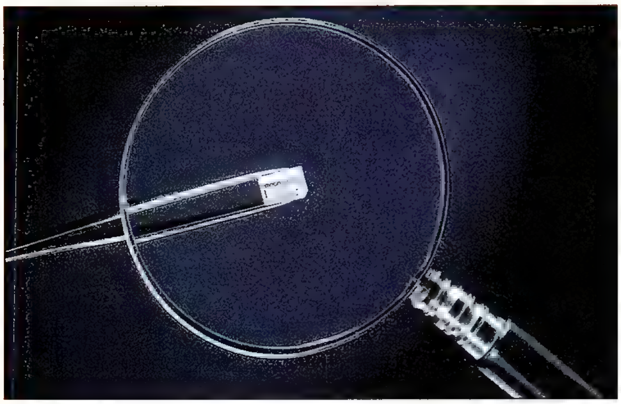


Omron's new G6K series of low-power relays, designed in Japan, are among the smallest relays available for signal applications, the company says. Its 'inside L' terminal design enables mounting on the PCB without dimensional clearances between footprints, so engineers can mount them end to end or side to side. Manufacturing prowess is among the innovations, the company says.

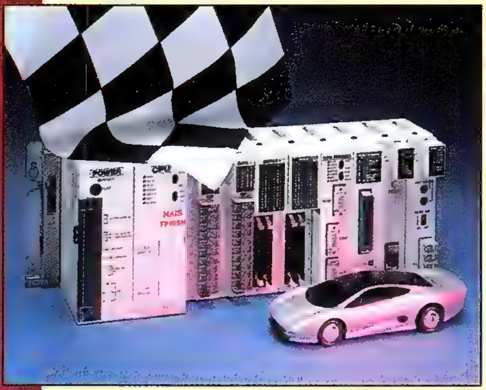
Aromat's Jack Gayara. Like many of their U.S. counterparts, they even get involved in testing.

"As a PLC design engineer in Japan, I went through all the testing when designs were complete," says Armoat's PLC Product Manager Junji Ichiriyama.

With that kind of complete involvement in projects, Japanese design engineers don't work on as many products in a year as their counterparts in the U.S. do. They typically handle only one or two projects a year, says Aromat's Gayara, vs. 18 for a U.S. engineer. But the stakes are high. THK America's Miyazaki says Japanese engineers often are required to come up with two new product designs a year. And, says Mark TenEyck, of Microcadam reseller FCI Systems, they better be a hit in the market, or the engineer's reputation could be stained.

Products to watch

Here is a list of the latest products from some of the major manufacturers doing design in Japan:

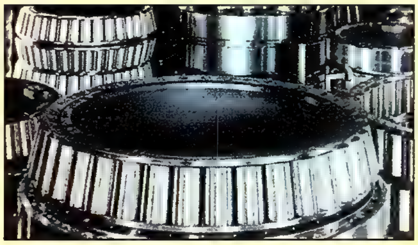


Dual CPU PLC

Aromat Corp.'s new NAiS brand FP10SH PLC compresses frequently used instructions into fixed-length form and employs a five-stage pipeline RISC processor to execute a sequence instruction at 0.4 µsec. It enables five instructions to be executed simultaneously. Aromat says it is four times faster than its precedessor, and 3 to 10 times faster than other PLCs.

Aromat Corp., (E) 629 Central Ave., New Providence, NJ 07934, FAX (908) 771-5658.

For information, circle 545

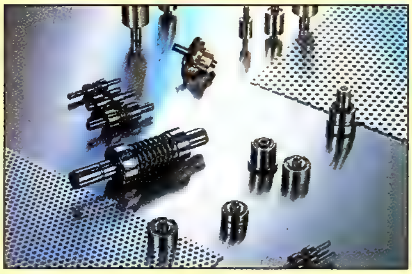


'Tough steel' bearings

NSK's patented "tough steel" ball and roller bearings are designed for long life, especially in harsh environments where bearing lubricants become contaminated with abrasives. The company says these bearings outlast standard bearing steel by as much as 10 times in those environments.

NSK Corp., (P) 3861 Research Park Drive, Box 1507, Ann Arbor, MI 48106, FAX (313) 668-7888.

For information, circle 546



Integral bearings

NMB's precision mechanical assemblies are designed for several markets. NMB's largest bearing is one-inch outside diameter, while the smallest is 0.1181 inch. The integral bearings are for computer hard disc drives, computer tape drives and camcorders, among other applications.

NMB Corp., (P) 9730 Independence Ave., Chatsworth, CA 91311, FAX (818) 709-0387.

For information, circle 547

Long-life bearings

NTN Bearing Corp.'s AS (Advanced Super-Performance) bearing series are the company's most durable. The series' TAB, ETA, and EA bearings are especially effective in applications where the lubricant contains hard particles such as in automobile transmissions. To prevent cracking, engineers prepare the rolling surface with a heat treatment process. They use special materials to multiply the treatment's effectiveness, inhibiting the occurrence of cracks and

One characteristic that Japanese and U.S. engineers share is the reliance on CAD software. But, in Japan, engineers are more likely to use 2D CAD while U.S. engineers, as a whole, use more 3D solids modeling. In fact, U.S. engineers, particularly in the automotive industry, have made the adoption of new engineering software a priority, while Japanese engineers often prefer to stick with what they have, analysts say.

Naturally, there are exceptions. D.H. Brown reports that Mazda uses CAE software to study the concerns of human workers interacting with machinery, and to create models of the assembly floor to detect potential problems. Of course, as the consulting firm points out, Mazda is owned by Ford. Overall, D.H. Brown says, Japanese companies would benefit from the interference checking, part-sizing analysis, and physical-property calculations that come with the kind of 3D solids modeling U.S. engineers use.

Still, just as Japanese engineers can learn from the U.S. approach to software adoption and implementation, U.S. engineering can learn from the Japanese tradition of emphasizing manufacturing and sharing data. U.S. automotive companies, for example, have failed to share information across product-development disciplines within an organization and throughout the supplier chain, says D. H. Brown. That failure can slow down design and make projects more costly due to the necessity of rework when mistakes show up downstream.

The remedy: Forget Kipling's famous claim that East is East and West is West, and let the twain meet, at least intellectually, to learn from each other. **dn**

(Design News *Technical Editor John Lewis contributed to this article.)*

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enhancing the life of the bearings to about five times that of regular bearings where hard particles are in the lubricant, NTN says. Strengthening the bearing surface also makes the bearing more resistant to peeling, smearing, and other surface damage, according to the company.

NTN Bearing Corp., (P) 1600 E. Bishop Court, Mt. Prospect, IL 60056, FAX (847) 297-2552.

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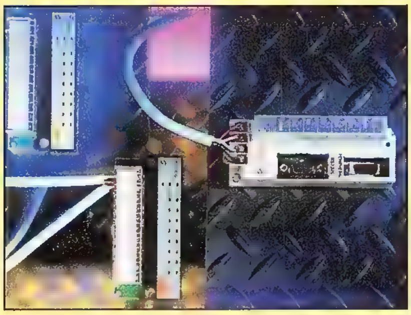

Micro network controller

Omron's new SRM1 micro network controller provides the power and flexibility of a high-speed distributed I/O network in an ultra-compact package, the company says. Based on the networking system rather than the controller's fixed I/O, the SRM1's I/O is distributed via Omron's CompoBus/S network. The company says the distributed configuration reduces wiring and offers machine builders flexibility to distribute I/O anywhere on the machine, rather than designing machines around the controller.

Omron, (E) One East Commerce Drive, Schaumburg, IL 60173, FAX (847) 843-7787.

For information, circle 549

High-resolution, high-torque step motor

Oriental Motor U.S.A. Corp. says its PK-M Series sizes 17 and 23 hybrid step motors provide the highest torque and step resolution combination available. Step angle resolutions are 0.9 degrees per full step and 0.45 degrees per half step while maintaining holding torques of 22 to 44.4 oz-inches for the size 17 and 54.2 to 187.5 oz-inches for the size 23.

Oriental Motor U.S.A. Corp., (P) 2580 W. 237th St., Torrance, CA 90505, FAX (310) 325-1076.

For information, circle 550

Guide actuator

THK America Inc. has introduced a miniature version of its LM Guide Actuator Type KR. It's available in two sizes: the KR20 and the KR26, with carriage heights of 20 mm and 26 mm, respectively. Both models include the integrated four-groove circular arc LM guide raceways. The outer rail construction is cold drawn steel. The KR20 features a 1.0-mm/rev precision ball screw and maximum travels of 20 mm. The KR26 features a 2.0-mm/rev precision ball screw and maximum travels of 300 mm.

THK America, Inc., (P) 200 E. Commerce Drive, Schaumburg, IL 60173, FAX (847) 310-1182.

For information, circle 551

In Japan it's CAM/CAD, not CAD/CAM

Designers don't have the detailing responsibilities common elsewhere

Adele Hars, Contributing Editor

If your company is a supplier to a Japanese manufacturer, you may shake your head from time to time as the raw CAD data for a new part comes in. How are you supposed to use this? Holes don't match up, surfaces are broken. How could they release this?

The reason is that the way design engineers use CAD in Japan is very different from the way North American users apply it. The kingpin of Japanese industry is manufacturing, which has an enormous influence on the role of CAD and the engineers who use it.

Minolta cut product development time for this camera in half by making the switch to 3D CAD.

"Typically, the data coming out of the design teams is very rough and approximate," says Christian Nardin, managing director of Dassault Systèmes KK, the Japanese subsidiary of the makers of CATIA. "It needs extensive rework by the production engineering teams, which have high expertise and know-how, a perfect understanding of the design intent, and a strong focus on quality of execution and reproducibility."

This focus on manufacturing means that designers are often absolved of detailing responsibilities that their U.S. counterparts might have. As Frank Kovacs, SDRC's director of marketing for Asia Pacific, notes, "2D is still used by more than 80% of the companies in Japan because the drawings are still the release mechanism and are considered to be 'art.' I think this process allowed Japanese companies to be very successful in the early '80s for improved quality and manufacturabilty compared with the U.S."

It also encouraged the use of manufacturing criteria in design decisions, says Marc Halpern, director of research, engineering, manufacturing and design, D.H. Brown Assoc. Inc. And, it was a key to keeping a tight reign on the bottom line. "The strong focus on minimizing manufacturing costs has significant benefits because they are eight to 10 times higher than design costs," he notes.

However, it has also meant that designers have traditionally not been given advanced 3D tools. Clearly, this is changing, especially in leading-edge industries. Scott Ikeda, a spokesperson for Fujitsu, notes that while 2D is still deeply rooted throughout Japanese industry in general, the automotive, electronics, and precision engineering industries are taking the lead in moving to 3D.

Ned Denison, senior director of Asia/Pacific sales and marketing for

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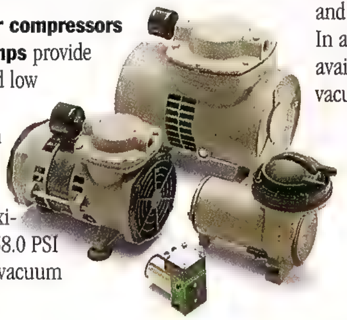

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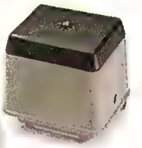
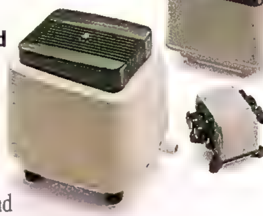


Linear air compressors and vacuum pumps combine high performance with high efficiency and are designed to meet the demand of high flow-low pressure (or vacuum) applications. Thomas Linear pumps have a maximum pressure of 7.7 PSI with a maximum vacuum of 15.7 In.Hg.



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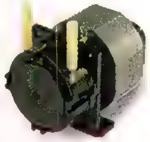

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Autodesk postulates that the evolution in the tools used by designers is dovetailing with the changes in how they are delivered to the desktop. "CAD was considered as a design-capture tool within a computer-integrated design and manufacturing context," he says. "It was built on a mainframe and was not integrated with the main computer system. Now that more CAD systems are based on networked PC technology, CAD is becoming an integral part of the design/manufacturing computer system."

CAM first. CAD systems that are fully integrated with CAM systems remain very much the exception. But use of CAM is very advanced, and arguably much more sophisticated than it is in the U.S. Denison says that this stems from the willingness of Japanese companies to invest internal programming resources to create custom CAM solutions based on packaged modules.

Until recently, at least, this has created a large schism between the worlds of CAD and CAM. Japanese manufacturing engineers are reputed to be among the most demanding anywhere. A proliferation of Japanese vendors, recognizing the importance of the domestic CAM market, have focused on perfecting their CAM applications.

Global products call for global teamwork

Reflecting their worldwide export, Mitsubishi Electric's mobile GSM phones are the product of a global development process.

Design takes place in Japan, where engineers use the Helix Modeling System from MICROCADAM. Production is in France, where manufacturing works directly from the Helix CAD data. Engineers in France also do the molds for the plastic parts.

"We were able to work in a global team and exchange models easily," says Michael Lentz, former Mitsubishi design group leader in France. "A person used to any CAD system would find himself at home with Helix."

This has left room for American CAD vendors, especially those with high-end 3D packages, to make inroads. Companies like Fujitsu, which is a major vendor in the Japanese CAD/CAM market, rely heavily on reselling 3D CAD software from companies like MICROCADAM, Unigraphics, and SDRC, primarily for the high end, while its own ICAD series is a big player for the mid-range.

WHILE 2D CAD IS STILL POPULAR IN JAPAN, INDUSTRIES SUCH AS AUTOMOTIVE ARE TAKING THE LEAD IN MOVING TO 3D.

Manufacturability drives analysis. The focus on manufacturing has also driven the analysis (CAE) market. Like CAM, CAE is an area where the Japanese may be ahead of the Americans. Many major companies that are still using 2D for design have nonetheless invested in sophisticated 3D systems for CAE.

"For years, Japanese companies have embraced the CAE portion of engineering and seen the benefits more than their U.S. counterparts," notes Kovacs of SDRC. "They have seen the advantage of simulation-based design to reduce costly prototypes, and the value of this based on increased quality and reliability."

Nikon, for example, has been using CATIA/CADAM DRAFTING (CCD) in 2D for core CAD, but I-DEAS for CAE in 3D for several years. While the company has not yet determined what 3D CAD package it will use, it will decide soon. "CCD and I-DEAS have had a great impact on cycle reduction time," notes Yoshihiro Fujino, manager of the Technology Systems Center. "However, both systems were not as efficient as expected in slashing cost. 3D becomes mandatory."

What is still rare in CAE in Japan is putting the tools in the hands of the designers themselves, a trend that vendors are now pushing in the U.S. The electronics giant Sharp is an exception in this area. The new Viewcam video camera marked the first time Sharp designers used SDRC's analysis tools. They did quick shock checks on components, a strength analysis on the cassette cover, a deformation check for a cylinder, and a plastic flow analysis of the cabinet prior to final design completion. The models were then used for rapid prototyping and mold creation.

The result? A 30% smaller camera developed in 75% less time. "Sharp reduced unnecessary processes by using the same data from design to molding," notes Hideaki Kata, manager of the CAE Center in Sharp's Product Engineering Development Div.

But what about all those companies who are using 2D for CAD and 3D for CAE? Does it make sense to build a complex 3D model just for analysis, but not for CAD or CAM? In fact, says Halpern, engineers do not have time to build complex computer models. Instead, he says, "Resourceful engineers with years of design experience build very simple finite element models that provide them with 80% of the information they need. These simple models capture the essence of the physical behavior that the engineers want to study. CAE technology is effectively used to identify well-defined laboratory tests that can be performed quickly to satisfy their remaining design information requirements."

Another factor that affects the way CAD is used in Japan is the way industry in general is organized. While U.S. companies have cut back drastically on the number of T1 suppliers, big Japanese firms still work directly with thousands of subcontractors, says Autodesk's Denison.

"Japanese primary contractors use a huge number of subcontractors for detailed designs and manufacturing of components," he notes. "Subcontractors are usually small companies and cannot afford to have various CAD systems to exchange data with primary contractors' data. So standard data exchange format is very important."

But while data exchange is important, many times it doesn't even reach that point, as Dassault's Nardin points out. "Paper drawings, and to some extent tapes, are the norm for exchanging data with suppliers," he says.

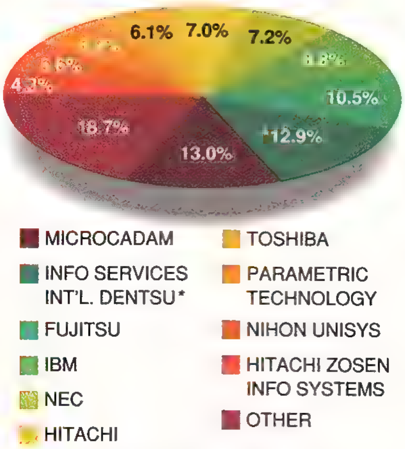
Of course, it makes it easier if everyone is using the same software. Big, leading-edge companies tend to have their suppliers working on-site, with everyone using compatible software. "These close relationships and working teams have different implications compared to the supplier OEM relationships in the U.S.," says Kovacs of SDRC. "Geographically, U.S. suppliers are typically more dispersed than their counterparts in Japan."

Japanese suppliers have to ensure that their CAD solutions can meet the needs of worldwide corporations. Hirotech, for example, develops and manufactures doors and other equipment for Mazda. Nobuhiro Konishi, an engineer in the tool design section of Hirotec says his company has been working in 3D using AutoCAD for six years. "Many companies have it, and it is used worldwide," he says. "We have engineers in the U.S. I'm using the Japanese version, and the U.S. members of our team are using the English version." However, he uses English only for annotations.

2D/3D. 2D clearly remains the design norm in Japan. This is changing, but most industry observers say not to look for a 3D revolution. "In Japan, the manufacturing process is based on 2D design data, and the transition to new design processes is slow," says Fujino of Nikon.

Who's who in CAD in Japan

% 1997 MARKET SHARE



** Info Services is SDRC's largest distributor, and distributes other CAD products as well.*

SOURCE: Dataquest

THE EXACT RANKING OF CAD VENDORS IN JAPAN BY SHARE DEPENDS HEAVILY ON HOW THE MARKET IS COUNTED. IN THIS CASE, DATAQUEST TRACKS DIRECT, INDIRECT, RESELLER, AND OEM SOFTWARE REVENUES.

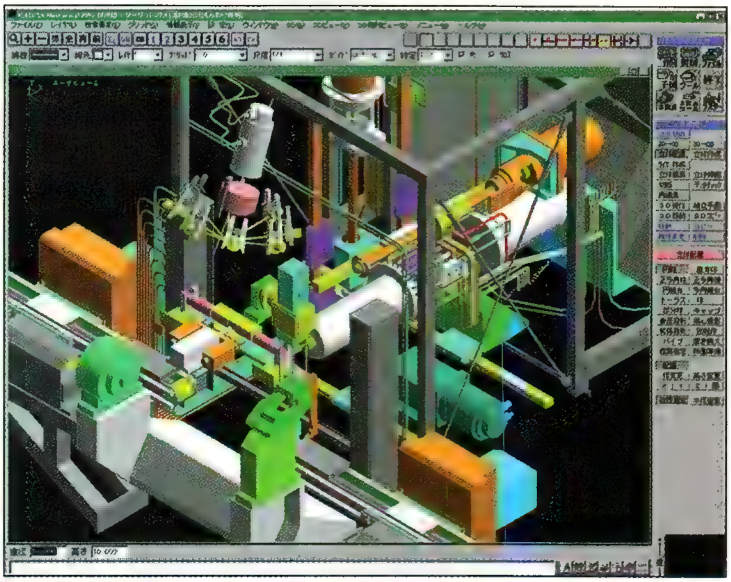
Dassault's Nardin explains that while there are some exceptions, there is typically a coexistence phase between 2D and 3D to facilitate the transition. This is in part due to cultural mores which include a respect for tradition, constant evolutions but no revolution, a bottom-up decision-making process, and conformity with accepted methodologies.

Kovacs of SDRC says, "The early adopters of the 3D technology seem to be those companies with very large complex assemblies (copiers, for ex-ample) and very expensive prototypes to find errors in. The benefits of 3D can be easily understood, and the pain from their previous efforts is reduced significantly using 3D CAD and CAE tools." He cites companies like Minolta and Sony as examples, or Fuji Xerox, which cut development time in half by moving to I-DEAS for 3D CAD.

Indeed, Nardin concurs, adding that "global" corporations are already in the process of implementing 3D digital mock-ups. He sees the trend most strongly in the automotive industry, which is far more advanced than other industry segments in terms of new technology implementation. "Companies like Honda that are using CATIA are paving the way to CAD, CAM, and CAE integration around a single master model," he says.

As IBM Japan recounts in a recent publication, there were problems getting Mitsubishi engineers to change their ways. Design engineers at Mitsubishi were faced with moving to 3D under CATIA. There was more than a little opposition regarding the introduction of the new system. Mitsubishi management gave various presentations and demonstrations, but resistance remained strong. Then, they prepared a demonstration using an actual truck design scenario. It compared the design tasks under the 2D application, versus the new 3D system. Seeing the actual drawings had an enormous effect. As IBM tells it, Mitsubishi engineers were comforted by the 2D/3D comparison because they were able to relate the new 3D process to what they were used to doing in 2D.

If some of the major companies go, others will soon follow, reports the



FUJITSU'S ICAD SERIES IS A BIG PLAYER IN THE MID-RANGE CAD/CAM MARKET IN JAPAN. AT THE HIGH-END THOUGH, IT RELIES HEAVILY ON RESELLING 3D CAD SOFTWARE DEVELOPED ELSEWHERE.

May 1998 edition of Daratech's (Cambridge, MA) *CAD/CAM/CAE Industry Update* newsletter. Mike Arashiba, president of Daratech's Tokyo-based partner FAMOTIK, was reported as saying that, "In three years, 3D will be the primary system among Japanese manufactures, due to increased competition and the tendency of Japanese companies to look at their peers. When Toyota, Honda, or Nissan are using more 3D and solids, then others will follow."

User's choice. When it comes to choosing CAD systems, users wield an enormous amount of power in the decision-making process. It is very different from elsewhere in the world. Vendors count on the fact that oftentimes in the U.S., one user or group might try out a new CAD package. If they like it, they might tell their colleagues about it and order some more. Not so in Japan.

"The Japanese companies want to see a leading-edge company implement the CAD system before they decide to purchase it," explains Autodesk's Denison. "This is due to their purchase decision-making process called 'ringi,' which dictates that one person cannot make a final decision and multiple managers have to approve it."

He also says that the Japanese are much more concerned with quality than Americans. This makes them very reluctant to buy a first-generation release or be the first to purchase a new upgrade. Dependability is part of the quality process in Japan and experimenting with new software is not consistent with dependability. "Americans are more likely to take a chance on new technology and accept the pain when it is not proven or dependable," he concludes.

A Fujitsu spokesperson, however, asserts that the days of in-house, proprietary systems are fast becoming a thing of the past. "Currently, most users, including those in the automotive industry, purchase commercially available systems," he says. "It is too time-consuming to develop systems in-house, and the level of commercially available packages is higher now. For CAM, 2D CAD, and limit-

Toyota develops its own CAD

While the Big Three have each settled on one primary CAD supplier, Toyota has taken a different approach. Based on technology from Nippon Unisys and Matra Datavision, the company has developed the "TOGO CAD/CAM System." "TOGO" is a Japanese word meaning "integrated."

Before developing TOGO CAD, Toyota had developed in-house systems for styling, structural design, and press die production. Although these systems helped reduce the time it took for the production of drawings and machining, Toyota says, they did not enable the company to shorten the overall development period sufficiently.

The problem was data conversion at each stage in the development process, preventing the company from realizing truly concurrent engineering. Engineers developed TOGO CAD to address this based on four requirements:

- High vertical integration
- Horizontal integration
- 3D
- Enabling of advanced simulations

With TOGO CAD, the goal is to use the same data throughout the entire development process. But the system, says Toyota, must also accommodate changes in design methods. The concept also involves the development of a hybrid system, in which surface and solid modeling can be used separately.

Finally, Toyota wanted to base TOGO CAD on technologies developed by other companies, specifically Nihon Unisys for 3D and Matra Datavision for design styling. TOGO Styling, based on technology from Matra Datavision, went into production use last summer. Toyota is also using CAS.CADE, Matra's object-oriented software development platform. Conversely, Matra plans to incorporate some of Toyota's developments into its EUCLID QUANTUM offering.

Toyota shortened product development time for its Land Cruiser using a highly integrated CAD/CAM system.

Toyota's design engineers in Belgium and the US are also using TOGO CAD. And while Toyota wants to encourage its suppliers around the world to use TOGO CAD, it realizes this is not always practical. For now, at least, it is relying on direct translators and IGES. Others are more closely integrated. For example, there is a direct interface between I-DEAS and TOGO CAD, so I-DEAS can be used as the CAE solution.

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ed-function PDM, Japanese companies tend to buy Japanese-made software. However, for 3D CAD, CAE, PDM, and PIM, U.S.-made software is more sophisticated."

Village engineering. Until recently, Japanese CAD users have not looked much beyond their 2D tools in the quest to implement concurrent engineering practices. Nardin puts it this way: "Concurrent engineering is actually performed today through 'village engineering' and traditional teamwork, rather than through electronic technology implementation. However, advanced thinkers now realize there are limitations inherent to the traditional methods, as globalization implies the extended enterprise, and pushes electronic business."

Furthermore, adds Kovacs of SDRC, design teams in Japan have always worked in teams and groups. "The concept of a specialist, not communicating with the group, is relatively unheard of," he explains. "Therefore the adoption of tools that focus around teams and team communication tend to perform better within the existing processes than stand alone tools."

Halpern even contends that Japanese automotive companies in particular still have a strategic advantage over their American counterparts due to optimized product development processes, despite the fact that they are working in a predominantly 2D environment. These processes, built upon a culture of effective communication and collaboration, have been embedded in 2D CAD practices that employ multiple CAx products across corporations, he says.

Automotive Exception

When in comes to exploiting new CAD/CAM/CAE (CAx) technology, the automotive industry is always a leader. Now, Japanese automakers are using a combination of CAx and optimized engineering practices to beat their competitors around the world in reducing engineering lead time. In fact, major Japanese manufacturers have cut the time between approval of exterior model design and start of product shipment to 20 months, well ahead of the 30 month average in the U.S. [source: *Business Week*, 9/8/97].

Raising the stakes, Nissan intends to reduce the lead time for next year's models even further, while Honda recently introduced a single flexible global car platform for three Accord models. The three models combined cost 20% less to develop than one Accord introduced four years ago.

But within this select group, Mazda may be poised to break ahead of its peers. Mazda (which is owned by Ford), is pushing the CAx envelope in a way that should have companies on both sides of the Pacific taking notice.

At a seminar in Tokyo last fall, the company highlighted key aspects of its advanced technology adoption strategy, known as the Mazda Digital Innovation (MDI) effort. At its core, MDI incorporates SDRC's I-DEAS Master Series for solids modeling, SDRC's Metaphase for Product Information Management, IBM's Lotus Notes for collaboration, and products from Tecnomatix Technologies for manufacturing process simulation.

JAPANESE AUTOMAKERS ARE EMPLOYING CAX TECHNOLOGY TO SLASH LEAD TIMES FOR NEW MODELS.

Mazda is investigating issues such as vehicle crash worthiness, noise, vibration, and harshness far earlier in the design cycle. Adjustments can then be made while the cost of change is significantly lower.

Mazda also simulates the manufacturing environment through the use of 3D models. These techniques enable the company to experiment with different manufacturing strategies without incurring a large overhead. For example, engineers now use CAE to study concerns of human workers interacting with machinery. By creating models of the assembly floor, they can detect potential problems in car assembly before committing physical resources to the plant.

—By Marc Halpern, director of research, engineering, manufacturing, and design, D.H. Brown Assoc. Inc.

Nardin notes that this is an area where the Japanese and Americans really diverge. "In Japan," he says, "the individuals are actually modeled around the manufacturing process. They show high commitment and dedication. U.S. visitors to Japan complain that back home the technology has to be extensively relied upon to do the job right instead of the people, and that design changes are not allowed after design approval at the design team level."

Change in the air. The way CAD is used by design engineers in Japan is clearly changing. But how quickly it happens is a matter of debate.

"You only have to look at the technical press to see a strong signal Japan is going to change dramatically in the near future," says Nardin. "It is amazing to see the quality of the in-depth technical features on advanced CAD/CAM/CAE/PDM technologies." Also remarkable, he says, are the many manufacturing R&D programs sponsored by Japanese public authorities, in cooperation with universities and industry.

Fujino of Nikon, however, takes a more long-term view. "In terms of new technology, US companies have a more open-minded approach, and new technology is easily accepted; whereas Japanese companies highly value tradition. Change will be linked to the process re-engineering of the entire company." And that doesn't happen overnight.

For more information

AutoCAD software from Autodesk (C): **Circle** 552
CATIA software from IBM/Dassault (C): **Circle** 553
I-DEAS software from SDRC (C): **Circle** 554
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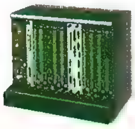

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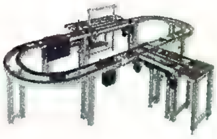

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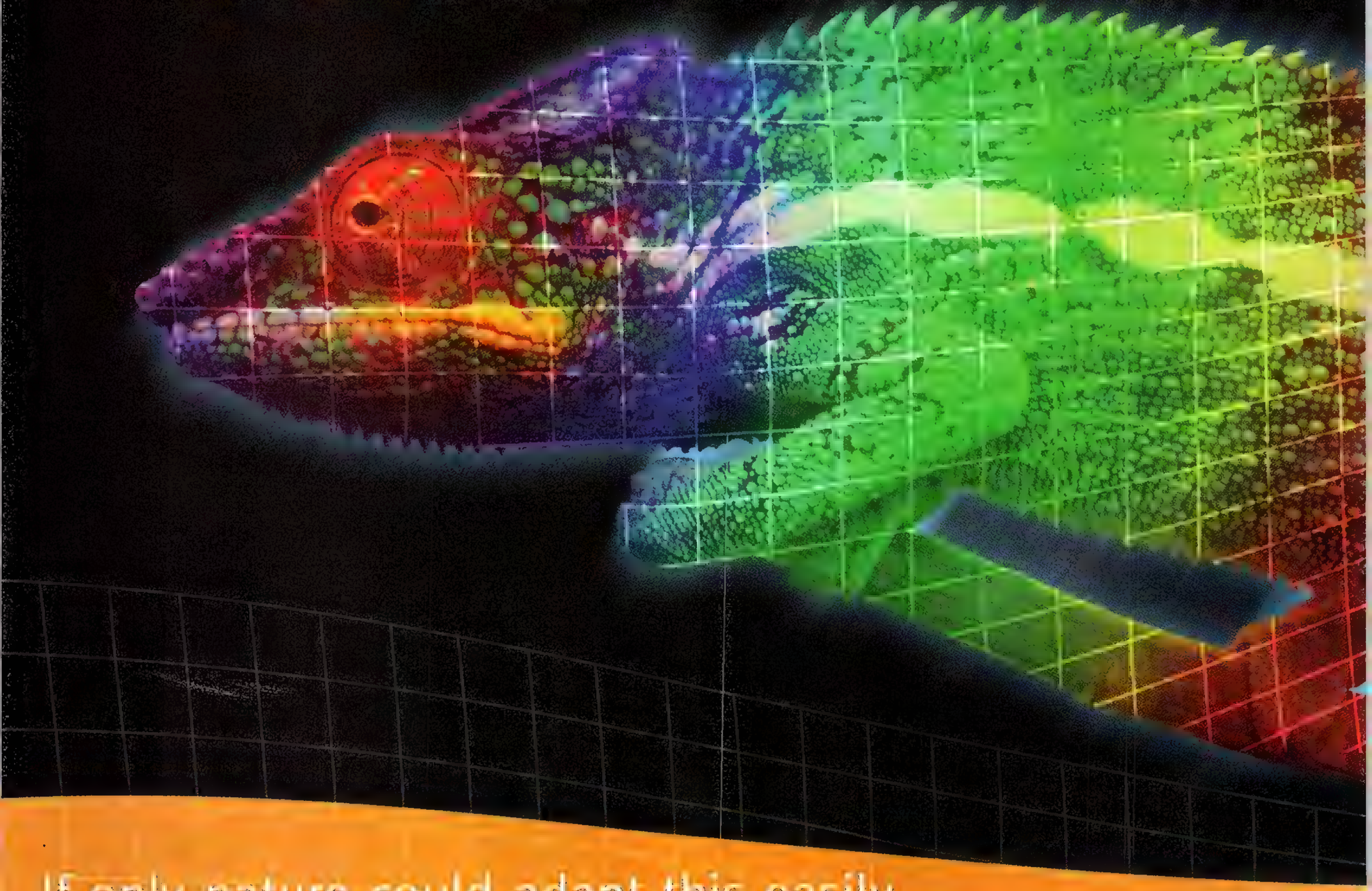

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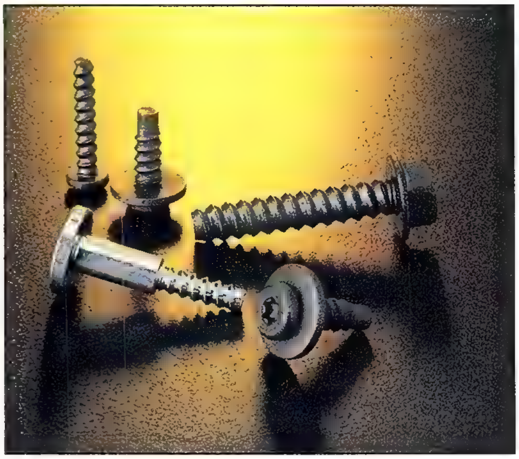
Circle No. 227

Assembly options grow

You've just designed a great new product, but need the perfect fastening solution to keep it all together. Lucky for you manufacturers of fastening and assembly products are focused on tackling your most challenging problems.
Here's a sampling of some of their solutions

Deana Colucci, Associate Editor

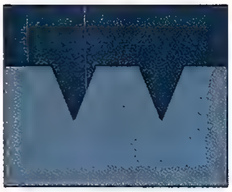
Fastener improves low-ductile performance



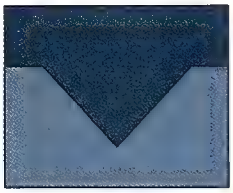
PROBLEM: In recent years, the use of die-cast magnesium in automotive, computer, and other applications has increased significantly. Unfortunately, fastening this material can be a challenge because of its low-ductile nature. For example, standard thread-forming fasteners, with a 60-degree flank angle, create excess debris. They can easily exceed the ductility limits of the material, causing damage to the formed threads.

SOLUTION: The patented Mag-Form™ thread-forming fastener features a lobular configuration, wide-spaced thread design, and broad flank angle. These features help eliminate costly and time-consuming tapping operations, and form strong mating threads in low-ductile materials, says manufacturer Camcar Textron.

As the fastener is driven, the high-degree flank angle *compresses* the mating material, rather than roll-forming it. This action creates strong mating threads while minimizing debris generation and decreasing the potential for fracture of the application material. And, the formed mating threads allow multiple removals and reinsertions of the fastener.



STANDARD 60-DEGREE FLANK ANGLE
THREAD-FORMING FASTENERS



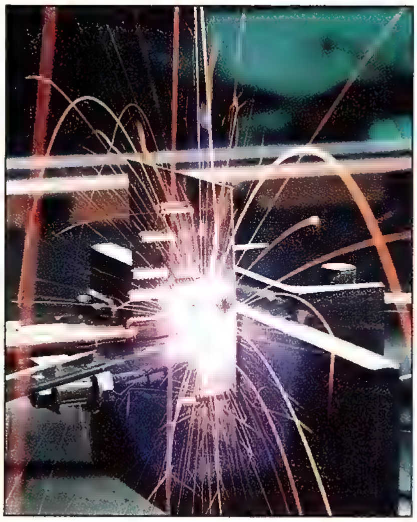
MAG-FORM
THREAD-FORMING FASTENERS

APPLICATIONS: Mag-Form fasteners are suited for use in a variety of automotive applications, including steering wheels, instrument panels, and powertrain components.
Camcar Textron: **Circle** **556**

Weld system compensates for changes

PROBLEM: Fluctuations in welding conditions, surface contamination, and changes in mechanical timing can interfere with effective welding.
SOLUTION: The self-diagnostic Stud Welding System (SWS) monitors and compensates for such changes. It comprises a TMP Welder Control, a Stud Feeder, and a weld gun.

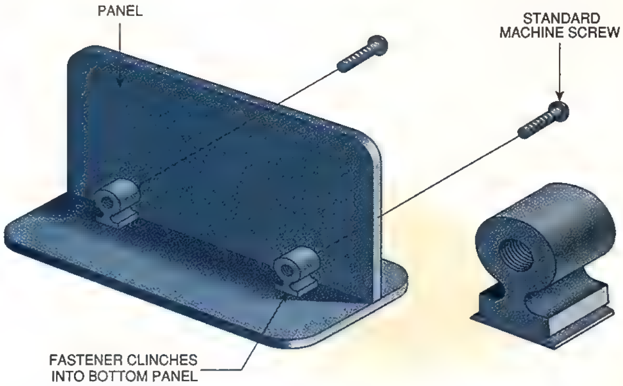
The TMP Weld Control switch-mode power supply provides timing and control functions for the system. A microprocessor performs thousands of finite electronic analyses, adjusting weld current, arc voltage, welding time, and stud-plunge timing to compensate for varying surface conditions such as oil, grease, and blemishes. Increases or decreases can be as much as 25% of weld parameter.



Wide ranges of weld parameter adjustments allow precise weld schedule control and tolerance monitoring with fault alert and out-of-parameter signaling capabilities. SWS software transmits fault signals to the weld controller after three consecutive parameter-tolerance violations at the same weld location. It then automatically replaces the welding tool without interrupting production.
APPLICATIONS: The Stud Welding System is suited for heavy transportation, machinery, construction, and furniture applications; as well as the manufacture of electrical, electronic, and recreation equipment.
Emhart Industrial: **Circle** **557**

Threaded fastener delivers strong right angle in thin sheets

PROBLEM: Thin panels make it difficult to create a strong right-angle attachment in sheet-metal applications. Cut-outs often made in panels to form right angles can reduce EMI/RFI shielding. In addition, bent tabs at the edges or in the middle of sheets, bent flanges, right-angle brackets, and tack welds can reduce design integrity.



SOLUTION: The PEM® steel R'ANGLE™ threaded self-clinching fastener provides a strong right-angle attachment point in both steel and aluminum sheets as thin as 0.040 inch (1 mm). These Type RAS™ fasteners are pressed into a rectangular punched hole in the sheet, mounting securely and permanently with the reverse side of the panel remaining flush. Once the fastener is mounted, the threads on the fastener enable a second panel to be attached to the first using a standard machine screw. The result is an extremely close-tolerance, tight fit that resists vibration and has excellent strip-out characteristics, says maker Penn Engineering.

Steel R'ANGLE fasteners are an alternative to bent tabs at the edge or in the middle of sheets, bent flanges, right-angle brackets, tack welds, and loose hardware. Zinc-plated for corrosion resistance, they can eliminate welding, eliminate tab cutouts for better EMI/RFI shielding, and decrease both the amount of loose hardware and the number of assembly steps. The screws can be removed and reinstalled repeatedly without compromising the fastener's holding power.
APPLICATIONS: Steel R'ANGLE fasteners can be used for component assembly in the electronic, automotive, aerospace, and telecommunications industries.
Penn Engineering & Mfg. Corp.:
Circle **558**

Large-head stud delivers speed and security

PROBLEM: Noise shields are often required to meet sound reduction standards. Unfortunately, secure panel attachment can mean more hardware and special panel preparation, increasing

assembly time and costs.

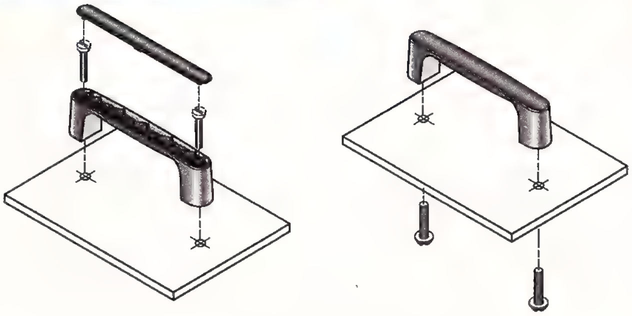
SOLUTION: Large Head Rapier Studs enable noise attenuation panels to be securely attached with a lightweight, low-cost fixing, yet be easily and quickly removed. The enlarged head diameter provides a simple and secure quarter-turn fixing method that eliminates the need for supports, washers, or any intermediate elements. Slip-on Long Reach receptacles complement the studs, giving support in ranges from 0.9 to 5.7 mm with maximum torque values of 22.15 in-lbs and 31 in-lbs across three variants.

APPLICATIONS: Quarter-turn Large Head Rapier Studs are suited for automotive applications, as well as for use in aerospace/aviation, transportation, engineering, office and computer equipment, and white goods assembly.

DZUS/DFS Int'l: **Circle** **559**

Handle offers easy installation

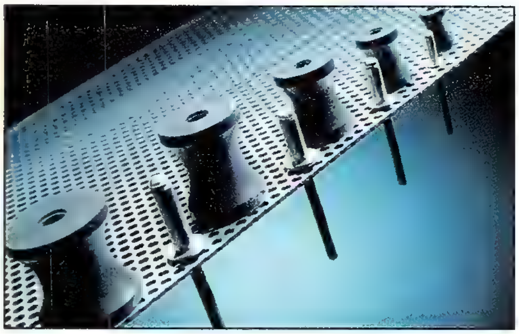
PROBLEM: In applications where access to the rear side of a door or panel is limited, a handle that mounts from the rear can be difficult or even impossible to install. The process can involve removing the gasket from the rear side of the door, installing the handle, then re-installing the gasket. Potential results: frustration, extra work for manufacturers, and damage to the customer's product.



SOLUTION: A new grab handle gives users the option of either front or rear installation. Mounting the handle from the front requires no gasket removal, making installation quick and easy, and saving on both time and installation costs, says manufacturer Southco. The mounting hardware is completely concealed by a snap-on cover, which can be stylized with custom colors or company name and logo. The non-corrosive handle is made of tough, high-impact ABS and has a maximum working load of 775N.

APPLICATIONS: The grab handle is suited for use in many types of cabinets, including gasketed refrigerator cabinets, as well as in furniture, medical equipment, power boxes, and enclosures.

Southco Inc.: **Circle** **560**



Rivets hasten fastening, save money

PROBLEM: When large quantities of the same type of fastener need to be installed in quick succession, time and installation costs can skyrocket.

SOLUTION: Patented SCHWINGMETALL® rivet mounts are attached by riveting tongs and a customary blind rivet, which is much faster than screwing, says manufacturer ContiTech. The rivet mounts comprise metal parts completely surrounded by natural rubber, which eliminates potential corrosion problems. The mounts can withstand pressure and shear force, and provide the same anti-vibration characteristics available with SCHWINGMETALL mounts with a threaded screw. They damp harmful shocks, insulate machine vibrations, reduce accelerations, and protect against unwanted noise.

APPLICATIONS: SCHWINGMETALL rivet mounts can be used in the automotive industry and in road construction, where they hold noise protection walls in place. In equipment manufacturing, the rivet mounts can be used to fasten sheet-metal parts, linings, and control cabinets. dn

ContiTech Formteile GmbH:
Circle **561**

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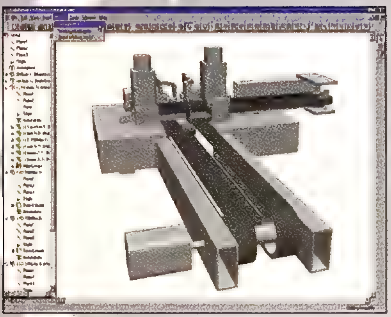

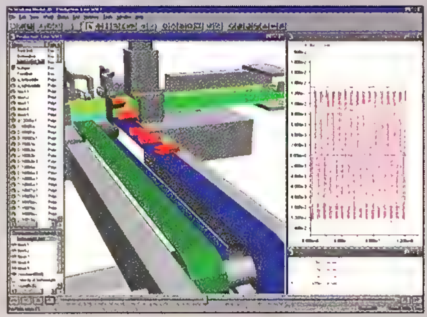

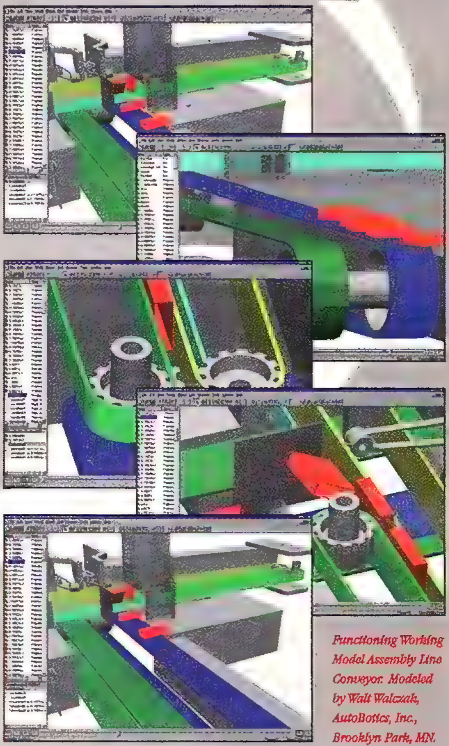

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Circle No. 228

an electric challenge to hydraulic steering

Microelectronics and software make an old concept newly competitive

Geoff Nairn, Contributing Editor

sVarity's electric power-
ted steering unit mounts
tly to the steering column.

Electric power-assisted steering (EPAS) has tempted automotive engineers since the 1950s. Even so, the promise of smaller, lighter, and more efficient systems never quite matched the low cost and performance of hydraulic power-assisted-steering (HYPAS).

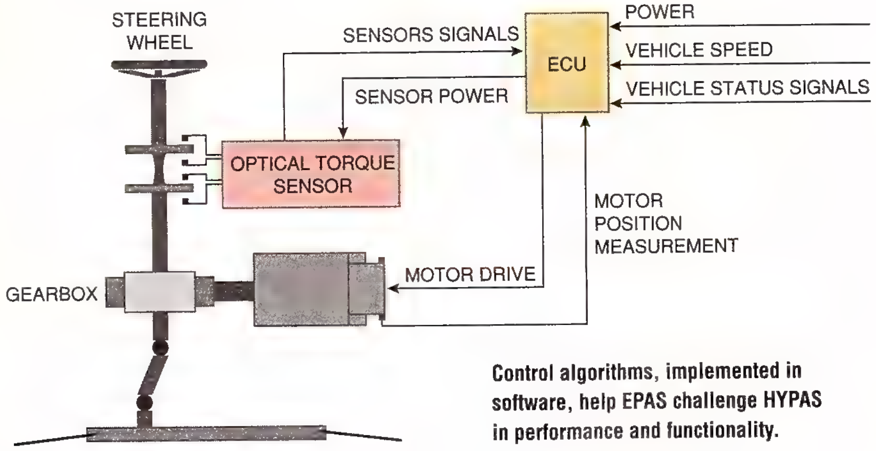
Advances in microelectronics, however, have rekindled interest in EPAS. Motor drive stages, electronic control units, and torque sensors can now be manufactured relatively cheaply. These components, coupled with complex control algorithms implemented in software, can rival or better the performance and functionality of conventional hydraulic steering systems. In addition, software can be fine-tuned to deliver the desired mix of stability, robustness, and steering "feel."

So says Tony Burton, control engineer with automotive component supplier LucasVarity plc (Solihull, England). The company is presently working on an EPAS system that offers a lower component count than HYPAS, is three to five kg lighter than a comparable HYPAS system, and consumes 4 to 5% less fuel. Attached to the steering column, the self-contained unit is said to be easy to install and particularly cost-effective on smaller vehicles.

"There are often considerable difficulties fitting HYPAS to a small car," Burton explains. The LucasVarity system, he estimates, could be installed in four minutes on a production line.

How it works. Operation of the LucasVarity EPAS is straightforward. An optoelectronic sensor measures driver torque applied to the steering wheel. The electronic control unit takes this measurement and, through the control software, drives the motor.

The brushless dc motor generates an


EPAS SCHEMATIC ARRANGEMENT

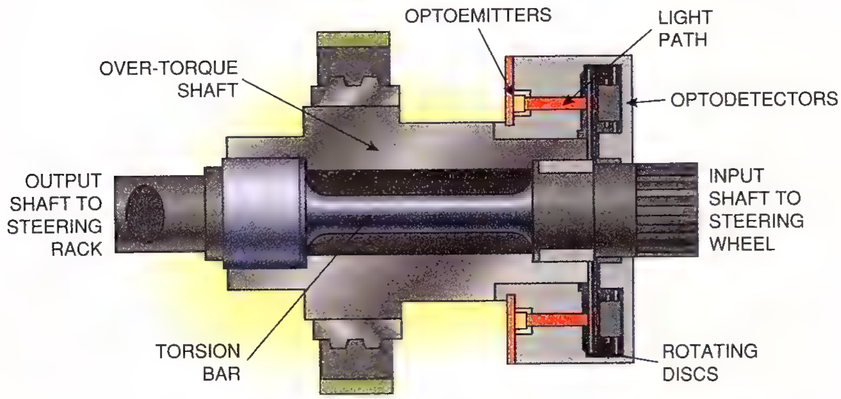
Control algorithms, implemented in software, help EPAS challenge HYPAS in performance and functionality.

In the new EPAS system, software allows **precise control** over steering behavior.

additional torque which acts through a reversible gearbox to the steering mechanism, assisting the driver. This assistance torque varies from about 15 Nm in a small "city" car, to 75 Nm in a larger car such as a Ford Taurus, and diminishes with road speed.

A frequent complaint made of HYPAS systems is their tendency to "over assist" the driver at higher speeds. In poorly designed systems, this can result in the vehicle oscillating or "yawing" around the center line as the driver attempts to correct the oversteer.

In the new EPAS system, software allows precise control over steering behavior. Algorithms programmed into the system define speed sensitivity, yaw damping, and steering self-centering. Added algorithms can give steering a "sports" feel or offer light load settings.


OPTICAL TORQUE SENSOR

EPAS optical torque sensor meets reliability, fault tolerance, and electromagnetic compatibility requirements while low enough in cost to mass produce.

A safety relay incorporated i design improves fault tolerance the electronic control unit in diagnostic functions for fault de and management. If the syste its "fail stop" design cuts all assistance and returns the driver t ual steering.

For a torque sensor, Lucas incorporates a dual-channel o device. Its non-contacting desig mechanical simplicity provide s reliability, while the use of optics immunity to EM interference.

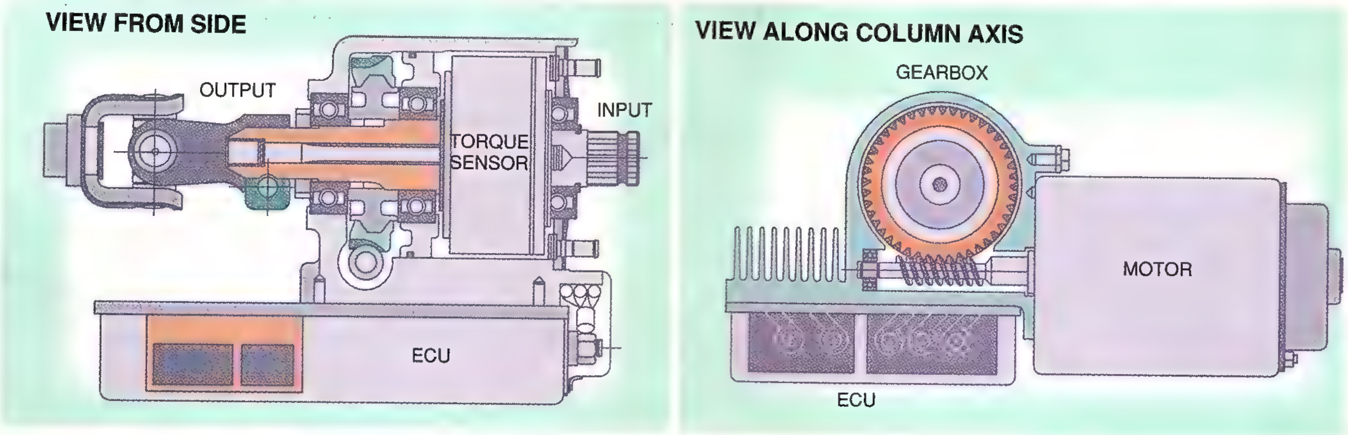
To operate, two patterned disks n on either end of the torsion bar se ing the steering wheel and steerin umn. Torque applied to the ste wheel creates a relative move between the two discs. Light inte reaching the photodetectors vari proportion to torque.

Because either detector can be us measure light intensity and thus to the system is redundant. Offset pa on the two discs, furthermore, allo software to calculate the ste wheel's relative position and veloci comparing the two sensor signals.

Motor design. Achieving a sm progressive feel at the steering requires a motor with low levels o ple and cogging torque. LucasV therefore, uses a three-phase inv to control motor phase currents hence torque. An array of power M FETS make up the circuitry; p width modulation (PWM) regu switching time and sequence fo MOSFET stages.

Since the power-switching s encompasses the most complex dyn ics of the whole EPAS system, optim tion requires computer simulat Lucas uses the Saber simulator prog from U.S. software house Analogy to analyze alternative PWM strate and to model the complex pattern secondary currents induced when MOSFET stages are switched.

The aim, Burton explains, is to en smooth control of the switching sta and also reduce the ripple currents into the battery harness. "These curr have to be filtered out to protect the e tronics in the EPAS control unit. minimizing the ripple current, we



Low-cost components mean EPAS systems can be engineered to cost the same as HYPAS while offering additional advantages.

able to use filter components with lower ripple specifications and, therefore, lower cost."

LucasVarity's Electric Power Assisted Steering system is targeted primarily at the European market where smaller cars dominate and the advantages of EPAS offer the greatest potential. "But there is no reason why the system cannot be scaled up to larger cars," Burton adds. The company claims to have negotiated a development contract with a leading European carmaker which could see EPAS installed on production models in the year 2000. **dn**

For more information

For more information on the products mentioned in this article, circle the following numbers on the reader service card:

EPAS from LucasVarity (P): **Circle**	.562
Saber simulator software from Analogy Inc. (C): **Circle**	.706
EPAS by SMI (P): **Circle**	.707
EPAS by NSK (P): **Circle**	.708
TRW (P): **Circle**	.709
Delphi Saginaw (P): **Circle**	.710

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If so, let us know. Circle No. 527

EPAS prospects, pros and cons

EPAS technology is new to Europe but has been available on small (600 to 800 cc) Japanese cars for more than 10 years. First systems to arrive in Europe were adaptations of Japanese park-assist units, such as the one incorporated in the 1996 Renault Twingo.

Developed in collaboration with the Japanese company Koyo, the Twingo EPAS provides assisted steering up to a speed of 65 km/hr. "EPAS know-how is now being transferred from Japan to France where production of EPAS systems will start within six months," claims Yannick Lacour, director of strategic planning at SMI, the Koyo subsidiary in Irigny (near Lyon, France).

Another Japanese manufacturer bringing EPAS into Europe is NSK. Its systems have been fitted into 1-ℓ Opel Corsas since 1997. NSK EPAS is also likely to be introduced on the 1.2-ℓ version of the Corsa, and is offered as an option on the new Fiat Seicento.

For more powerful vehicles, some manufacturers are starting to develop a hybrid approach to EPAS technology. These are electro-hydraulic steering systems, which use an electric motor to drive the hydraulic pump, rather than driving it off the engine.

As a result, the hydraulic pump runs independently from the engine, and needs only run when power support is required at the steering wheel. It gives a fuel savings of 0.2 litre per 100 km, claims Karl Mauer, Opel spokesman, whose company is adopting a hybrid system on the new Astra being released this year. The suppliers are TRW and Delphi Saginaw.

Many vehicle manufacturers are, however, not satisfied with current EPAS performance. "Right now they don't give the comfort and safety we want to provide our customers with," remarks Marc Boucque, R&D spokesman at PSA. He talks of a "sticking" phenomenon, meaning that the steering wheel does not go naturally back to its original position after it has been turned. However, Boucque expects EPAS performance and cost to reach an acceptable level by 2000 when PSA will incorporate it widely into their models.

Ford, like PSA, is not satisfied with current EPAS performance. "We are not dismissing the technology, but we have evaluated 12 of the systems that are currently being developed or in production and none provided a satisfactory dynamics performance," reports Ulrich Eichhorn, manager, vehicle dynamics, advanced vehicle technology and small and medium car vehicle center, Ford Automotive Operations.

"They feel artificial because they suppress feedback from the road. Vehicle response is not what we would like it to be," he adds. Ford will probably use electro-hydraulic technology as a first step towards EPAS because it works with existing hydraulic systems, Eichhorn indicates.

—Anna Kochan, UK

How to design plastic gears

Zan Smith, Ph.D,
Staff Engineer
Ticona
Summit, NJ

Except for off-the-shelf gears, plastic gears are never designed alone but in mating sets with specific functions. Plastic transmission design and development must therefore take into account the broader relationship of materials, drive layout, shafting, bearings, and housings.

While plastic gears give the engineer enormous flexibility, they are much more complicated to design and develop than those in metal. Injection-molded gears can achieve high quality standards. However, plastic properties and dimensions will change over the range of operating and environmental conditions. This means the engineering effort to accommodate such changes is accordingly greater.

The first step for the project engineer responsible for building a plastic transmission is assembling the expertise required. For most successful plastic transmission designs, the project engineer requires the cooperative effort of a gear engineer, plastics engineer, manufacturing engineer, quality-control engineer, molder, tool builder, and resin supplier. The team needs application information, first to choose a drive concept, then to select the appropriate materials.

Each gear set is sized first for nominal operating conditions, then modified by optimizing for worst-case operation. Computer programs enable drive designers to model gear sets in worst-case scenarios and make the required engineering decisions to optimize the gear set.

For more information on plastic gear design (M) Circle 503. To speak with a Ticona representative, call the Ticona technical hot line at (800) 833-4882.

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  - TEMPERATURE
  - CHEMICAL MOISTURE
  - MOISTURE EXPOSURE
- **LUBRICATION**
- **TEST REQUIREMENTS**
- **OTHER**

Typical list of design requirements for a transmission involve the above considerations.

Rules of thumb for O-ring design

Mark Messinger
Engineer
Apple Rubber Products Inc.
Lancaster, NY

Elastomer seals are unlike many other materials that design engineers confront. Metal or plastic parts, for example, are probably failing if visibly distorted. But an O-ring *must* be deformed to function properly. In fact, an O-ring that is not compressed in its application is the wrong O-ring.

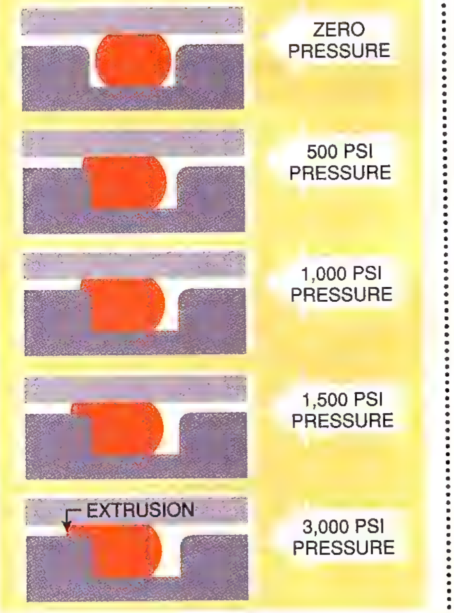
The following list provides some "rules of thumb" for an engineer to consider when designing an elastomer O-ring:

- A stretch greater than 5% on the O-ring I.D. is not recommended, because it reduces the seal's cross section and can lead to a loss of seal compression.
- A *groove* depth is the machined depth into one surface, whereas a *gland* depth consists of the groove depth, plus diametrical clearance, and is used to calculate seal compression.
- To create seal compression, the groove depth must be *less* than the seal cross section. To compensate for this compression, the groove width must be *greater* than the seal cross section, thus allowing the seal room to "flow."
- The maximum volume of the O-ring should *never* surpass the minimum volume of the gland.
- For reciprocating seals, passing O-rings over ports is not recommended. Nibbling and premature wear and seal failure will result.
- The closer the application is to room temperature, the longer an O-ring can be expected to effectively seal.
- Avoid using graphite-loaded seals with stainless steel. They tend to pit the stainless-steel surface over time.
- Before installation, and where applicable, make sure to lightly coat the O-ring with a compatible lubricant.
- When using only one back-up ring, be sure to install it on the low-pressure side of the O-ring.

You will find in-depth information on each of these rules and more in the new *Seal Design Guide* published by Apple Rubber Products.

For more information on O-ring design (M) Circle 504. To obtain a copy of the Seal Design Guide, phone (800) 828-7745.

EFFECT OF PRESSURE ON O-RINGS



The design of elastomer O-rings must take into consideration critical operating factors. For example, differential pressure affects an O-ring by forcing it to the low pressure side of the gland, causing the cross section to distort. If the O-ring cannot resist increasingly high pressure, part of it will be forced (extruded) into the diametrical gap, leading to premature failure.

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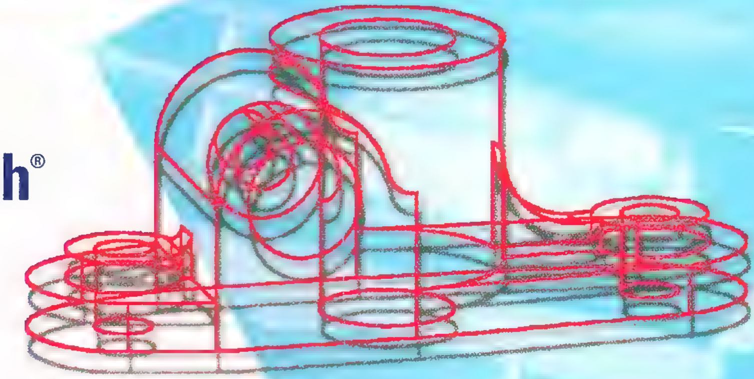

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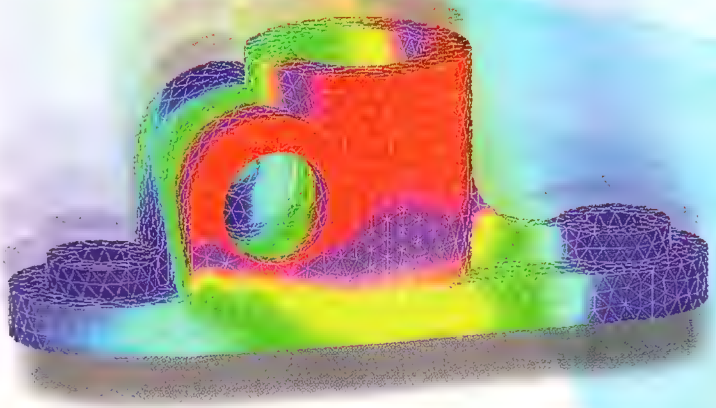

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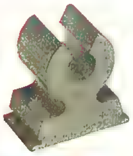
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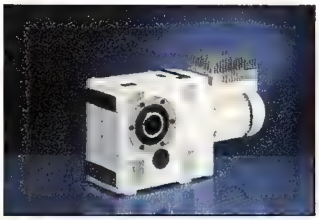
For information, circle 600



Motors

Variable-speed drive combines a geared motor and the intelligent frequency inverter 8200 motec, and can be installed without an additional control cabinet or wiring. The frequency inverter construction allows a separate assembly in the machine wall, and the compact geared motor can be integrated into the machine. The speed can be set via a switch/potentiometer unit, a manual terminal, or a RS232 interface. The whole drive can be connected to a superimposed host, using fieldbus modules. **Lenze GmbH & Co. KG**, Postfach 10 13 52, D-31763 Hameln, Germany, FAX +49 5154 82 2800.

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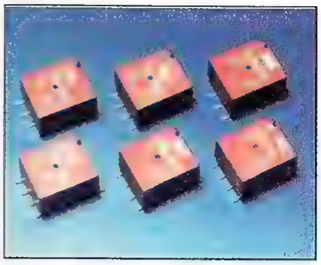

Chokes

Compact ISDN common-mode chokes surface-mount technology (SMT) are inductive components for telecommunications applications. The chokes are designed in the compact package 5024 and are for SMT. The use of amorphous cores can increase the dc load current up to 0.6A. **Vacuumschmelze GmbH**, KB-PM B 2, Dr. Lehmann, Germany, FAX +49 61 81 38 8 26 29.

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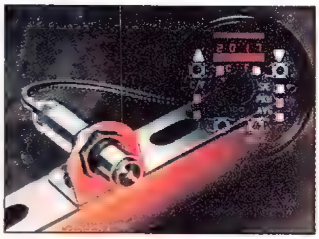
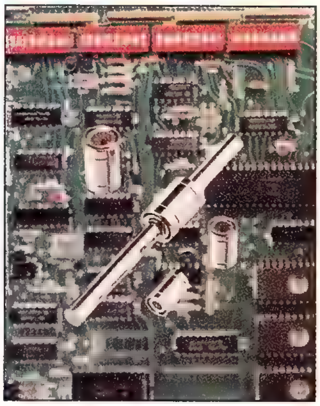


Thermometer

Marathon MR1F fiber-optic ratio thermometer measures temperature in hot, hostile environments; in high electromagnetic fields; and in other difficult applications where the line of sight to the target may be obscured. The MR1F consists of a small, rugged optical head; a field-replaceable, fiber-optic cable; and a separate electronics enclosure with built-in user interface. Proprietary signal processing electronics support advanced features such as remote sensor set-up, real-time display of target temperature, and field-calibration software. **Raytek Corp.**, Box 1820, Santa Cruz, CA 95061, FAX (408) 458-1239.

For information, circle . . .603



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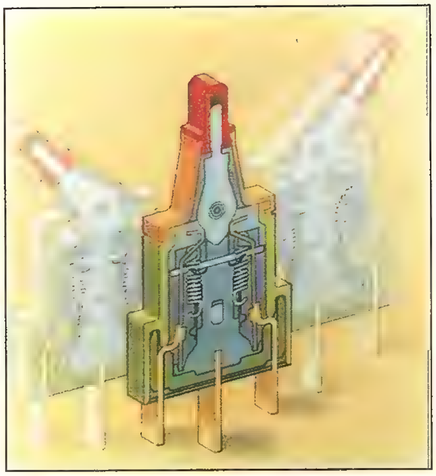

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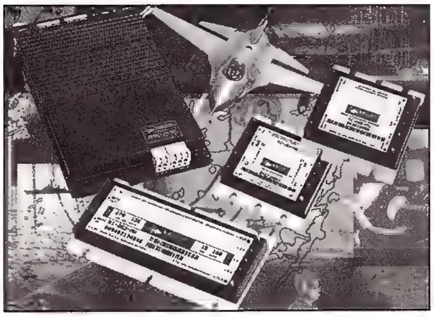

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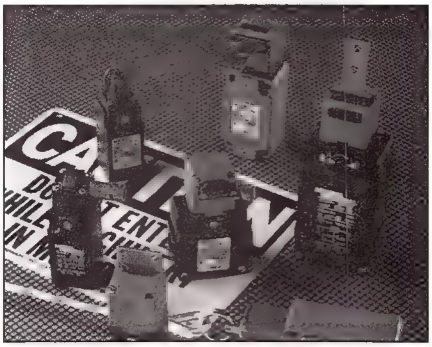

Switches

Mechanical safety interlock switches detect the opening of guards, including doors, gates, and/or removable covers, that prevent access to dangerous parts of a machine. The switches also help deter tampering with the guards or the internal machine controls. All safety switches are equipped with positive opening contacts, which open whenever an unsafe condition is detected, causing the machine to automatically shut down.

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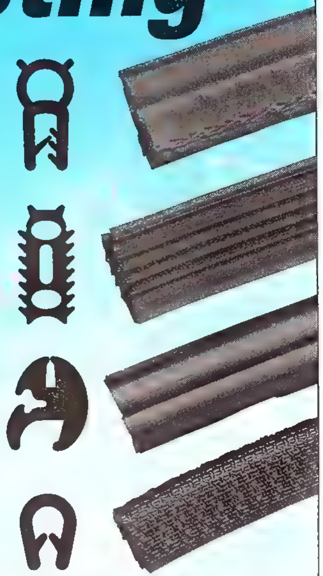

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For information, circle 613

SRAMs

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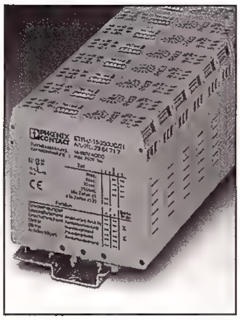
For information, circle 614

Relay



Electronic Timer Relay (ETR) is a 22.5-mm narrow module which allows the user to adjust all timing functions via front potentiometer and DIP switch array. The relay also features a broad time range of 40 msec to 2,500 sec, and "universal" input voltage of 18 to 285V ac/dc. The ETR's industrial housings are DIN-rail-mountable, and single lines are securely connected from a screw connection technology.

Phoenix Contact Inc., Technical Service Dept., Box 4100, Harrisburg, PA 17111, FAX (717) 944-1625.
For information, circle 615

IGBTs

Generation 4 rugged 600 and 1,200V motor control IGBTs provide power to motor drive systems at a smaller size. The IGBTs are available as discretes and Co-Packs. Packages available include the TO-220, TO-247, Super-247, and the surface-mountable DPAK.

International Rectifier, 233 Kansas St., El Segundo, CA 90245.
For information, circle 616

Power supplies

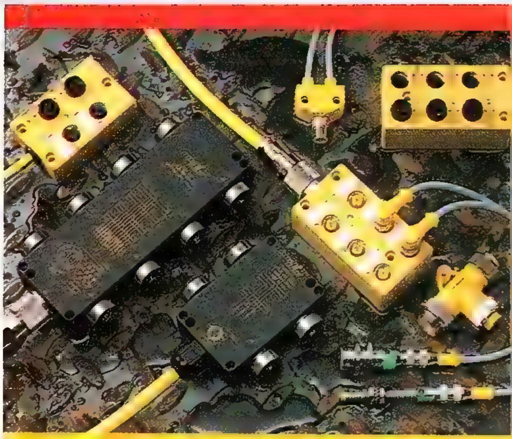
SDN Series power supplies attach to a DIN rail without tools, screws, or brackets and feature a front panel with indicator lights and rugged screw terminals. The units' electrolytic capacitors have been limited to an absolute minimum of four, using long-life versions specified to 105C. The units are also industrial load-compatible, and have a reserve capacity so that a small overload does not cause immediate failure.

Sola/Hevi-Duty, 90 Fieldstone Ct., Cheshire, CT 06410.
For information, circle 617

Switch

The F-3000 Series pressure switch is factory-preset in the range from 3 to 50 psi and features pipe, panel, or circuit board mounting. The switches also feature SPDT contacts, an operating speed of 25 m/sec, and can optimally function in temperatures ranging from 40 to 185F. The series has a variety of electric terminals to choose from including solder, pc-board, and a gold contacts option.

Airtrol Components, 17400 W. Liberty Lane, New Berlin, WI 53146, FAX (414) 786-0211.
For information, circle 618



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Valves

The D1FM Series of electrohydraulic proportional directional control valves are servo valves with high resolution at low command inputs. Precise control of position and force loops and machine tool feed rates can be achieved. The valve incorporates drive electronics with an integral LVDT for continuous monitoring of the spool position. A zero-lap spool is available for closed-loop applications with two different "power down" configurations.

Parker Hannifin Corp., Hydraulic Valve Div., 520 Ternes Ave., Elyria, OH 44035.

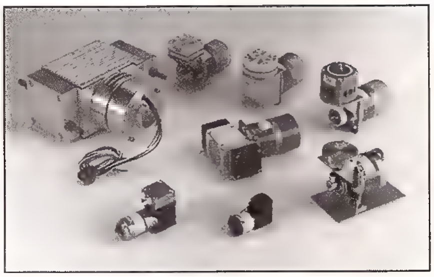
For information, circle 619

Pleat pack elements

RePak™ replaceable pleat pack elements have been designed in conjunction with a reusable center tube that allows the pleat pack to be crushed or incinerated, reducing disposable costs and minimizing environmental concerns. Applications include industrial lube oil and hydraulic system applications.

PTI Technologies Inc., 950 Rancho Conejo Blvd, Newbury Park, CA 91320, FAX (805) 375-2296.

For information, circle 620

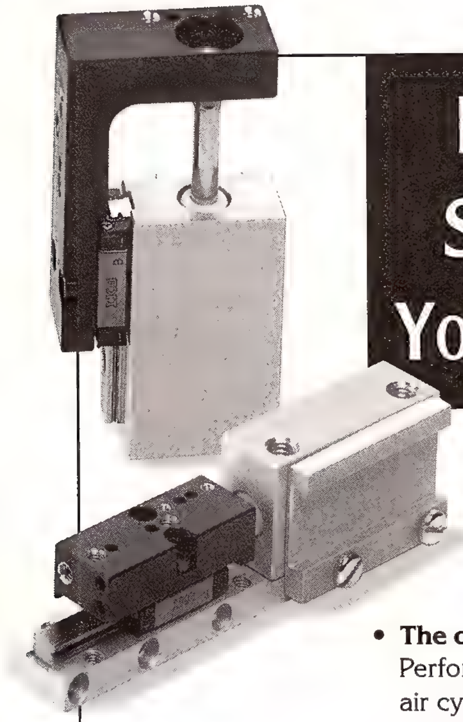


Diaphragm pumps

BLDC models of diaphragm pumps range in flow rate from 0.1 to 40 LPM, and combine a patented, FEA-designed diaphragm and valve system. Standard wetted materials include diaphragms coated with Teflon resin for high resistance to harsh chemicals. The pumps can be teamed with brushless dc motors with internal driver electronics.

KNF Neuberger Inc., 2 Black Forest Rd., Trenton, NJ 08691, FAX (609) 890-8323.

For information, circle 621



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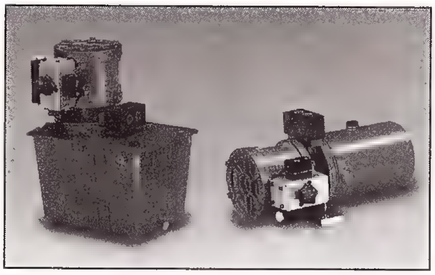
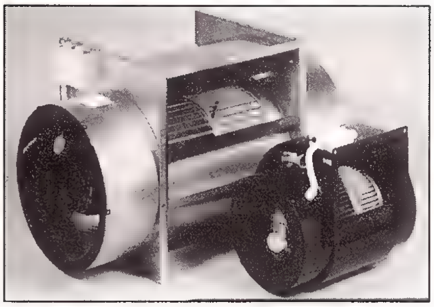


Hydraulic pump

Model P820 high fluid flow, double-acting, air-driven hydraulic pump is used in traditional fluid power applications, or in place of electrically driven power units where electricity is not available, or where explosion-proof operation is required. Available are five ratios with pressures up to 4,000 psi and flows up to 9 gpm, using 30 to 100 psi air supply. The pump can be mounted horizontally or vertically, fitted on an existing reservoir, or supplied with an integral reservoir of ⅔ or 2½ gal capacity.

Hydronic Corp., 32613 Folsom, Farmington Hills, MI 48336, FAX (248) 478-3689.

For information, circle 622



Fans

GBDF and SSDF Series of high-powered flue dilution fans allow flexible sitting of gas boilers rated between 80 and 650 kW input. Available are five sizes for industrial and commercial boilers rated up to 650 kW input. Each size is available in standard form for atmospheric boilers and water heaters of around 75% accuracy.

Airflow Developments Ltd., Lancaster Rd., Cressex Business Park, High Wycombe, Buckinghamshire HP12 3QP, England, FAX +44 1494 461073.

For information, circle 623

Cylinders

All-stainless-steel pneumatic and hydraulic cylinders convert pneumatic or hydraulic pressure into mechanical linear motion. Available are 303 and 316 cylinders with mounts, and bore sizes 22, 28, 38, 50, 63, 76, and 101 mm. Strokes range from 4 to 3,300 mm, and styles include single- and double-ended, back-to-back, tandem, and multi-position. Applications include use in chemical environments and wash-down situations.

Allenair Corp., Box 1896, New Haven, CT 06508, FAX (203) 287-8099.

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Heat exchanger

SSCF shell-and-tube heat exchanger can handle high pressures and temperatures, as well as high levels of particulates. Pre-engineered, with all fluid contact parts made of stainless steel, the heat exchanger is available in a range of sizes and capacities. The SSCF can be assembled from stocked components, and is available with ASME code construction, if desired.

ITT Standard, Box 1102, Buffalo, NY 14240.

For information, circle 625

Valve

Pressure- or vacuum-piloted three-way valves feature adjustable pilot set points, and normally open or normally closed valves are available. Also available are four mounting styles: flush, manifold, panel mount, or pipe thread. Pilot adjustment ranges from 0.5 to 100 psi or 1 to 28 inches Hg. Maximum signal pressure is 100 psi or 29.9 inches Hg.

Air Logic, 5102 Douglas Ave., Racine, WI 53402, FAX (414) 639-5996.

For information, circle 626

Fan

The 4715KL dc fan features a tach output, alarm sensor, and 130 cfm to provide higher air flow. Size is 120 × 38 mm. The fan provides the performance level of a 5-inch fan with the added benefit of a smaller frame. The 4715KL meets all UL/CSA, VDE, and CE requirements.

NMB Technologies Inc., 9730 Independence Ave., Chatsworth, CA 91311, FAX (818) 341-8207.

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Module

Type HMP linear module is the central drive component in the modular system for handling and assembly technology. Its rigid basic design, using an extruded aluminum profile, ensures minimal deformation under load. The guide system consists of a cylinder integrated into the guide with double bearings.

Festo AG & Co., Pneumatics Div., Ruiter Strabe 82, 73734 Esslingen, Germany.

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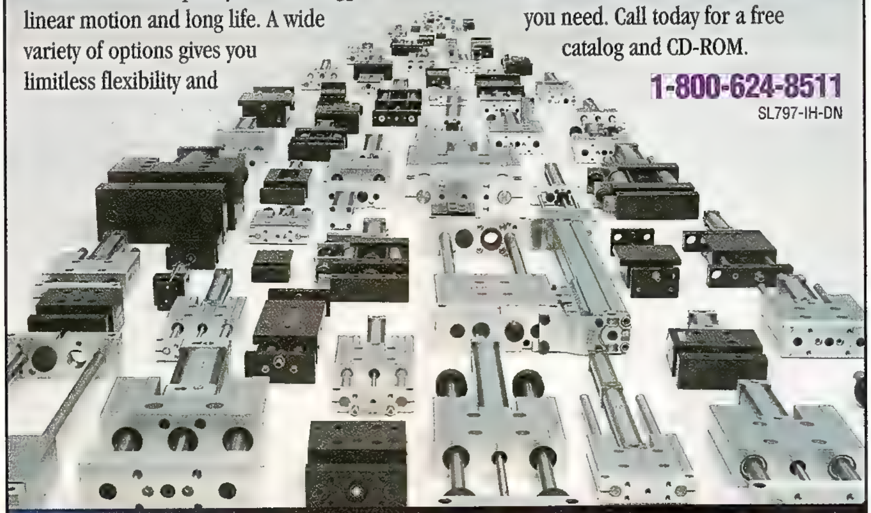

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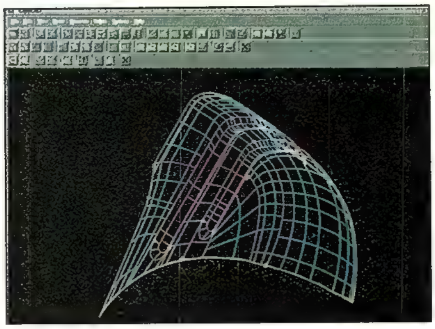


Reverse engineering software

CopyCAD is a reverse engineering product that can accept data from coordinate measuring machines, tracing machines, or laser scanners, and then generate surfaces for export to any of the major CAD systems. The software has increased flexibility for the construction of surfaces, and provides alternative triangulation methods to cope with different scanning strategies. Reverse engineering can be beneficial in product development, because the CAD models can be used in computer visualizations and animation, or as the basis for detailed engineering analysis.

Delcam Plc, Small Heath Business Park, Birmingham B10 OHJ, England, FAX +44 121 766 5511.

For information, circle 630

Processor

The SP5MX1 Intel mobile Pentium processor features a mobile MX chipset with a PCI/DRAM/cache controller and a DRAM data path controller. Other features include pull-up resistors and decoupling capacitors. High frequencies and critical signals remain inside the MCM.

Electronics Laboratory, ETZ-H97, Gloriastrasse 35, CH-8092 Zürich, Switzerland, FAX +41 1 6321210.

For information, circle 631

Printer

Bizworks 406 digital copier and 1,200 × 600 dpi laser printer is an imaging peripheral that couples digital copier and laser printing technologies in a small footprint. The machine features a flatbed design that allows standard single-sheet copying, as well as the reproduction of bound and odd-sized materials such as books, magazines, invoices, and checks.

Ricoh Corp., 475 Lillard Dr., Sparks, NV 89434.

For information, circle 632

featured product

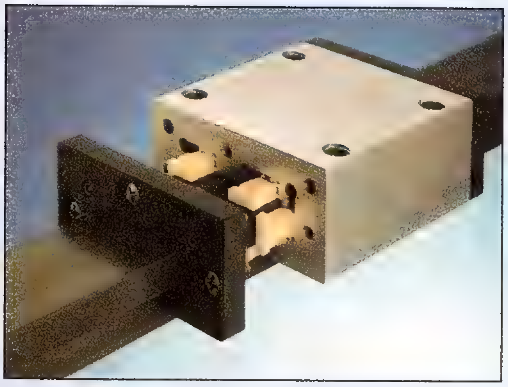
Linear guide system is adjustable, oil-free

Developed for applications in the automation and materials handling industries, DryLin®T guide rails from igus GmbH offer high acceleration, low maintenance, and a large static-load rating in all directions. Key components: a hard-anodized aluminum rail, clear anodized aluminum carriage, and replaceable slide inserts made of iglidur®J bearing material.

Though dimensionally interchangeable with standard ball bearing rail guides, the DryLin T linear guide system weighs 50% less. Replacing metal rollers with slide inserts of engineered polymer not only means less weight, but quieter operation and greater shock/vibration resistance. Versatility, however, is the biggest advantage.

"Rather than extreme precision," says igus President Frank Blase, "our development objective for the DryLin T was a robust linear guide system designed for reliable use in the widest range of different environments."

All DryLin carriages, Blase points out, are adjustable; running clearances can be increased or decreased as needed. Low moisture absorption allows use in wet or humid environments—the system can even operate underwater. Similarly, DryLin T guide systems are resistant to a variety of chemicals, including weak acids, fuels, and lubricants. Other benefits include excellent wear/abrasion resistance; dry running, in many cases without wipers or seals; a -40 to +90C temperature range. Additional information, contact: igus GmbH, Spicher Str. 1a, 51147 Cologne, Germany, Tel: +49 2203 9649 0, Fax: +49 2203 9649 222. dn



Available in four sizes—15, 20, 25, 30—at lengths to 6 m, DryLin T is equipped with adjustable gliding elements made of iglidur J. Maximum speed is 10 m/sec; maximum load rating is 14,000N static, 2,000N dynamic.

—David J. Bak, International Editor

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Du Pont (U.K.) Ltd., Maylands Ave., Hemel Hempstead, Herts HP2 7DP, England, FAX +44 1442 218646.

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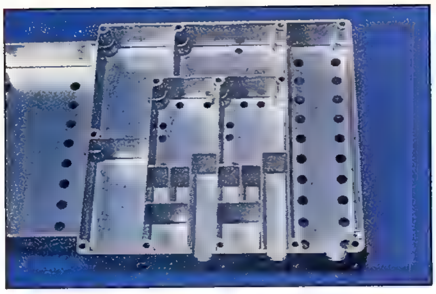

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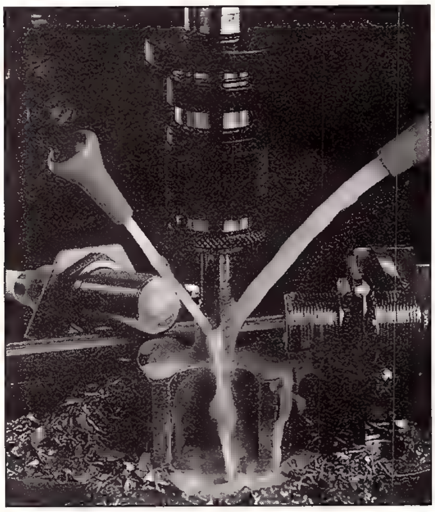
Instrument Specialties Co. Inc., Shielding Way, Delaware Water Gap, PA 18327, FAX (717) 424-6213.

For information, circle 634



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Rogers Corp., Box 188, Rogers, CT 06263.

For information, circle 635

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Emerson & Cuming Specialty Polymers, 46 Manning Rd., Billerica, MA 01821.

For information, circle 636

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JPS Elastomerics Corp., 9 Sullivan Rd., Holyoke, MA 01040, FAX (413) 552 1199.

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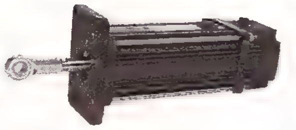

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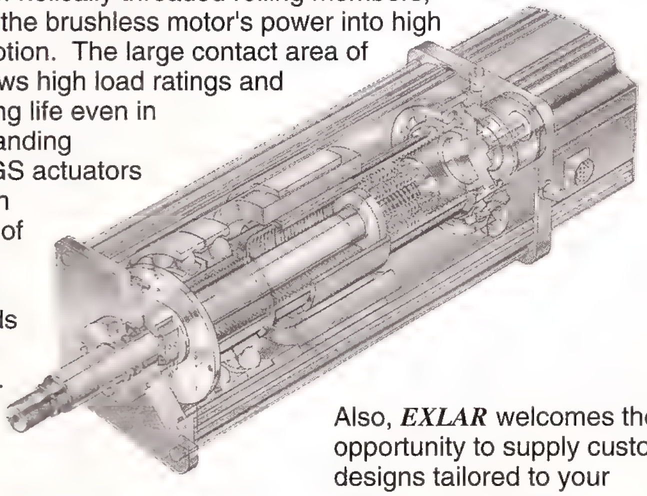

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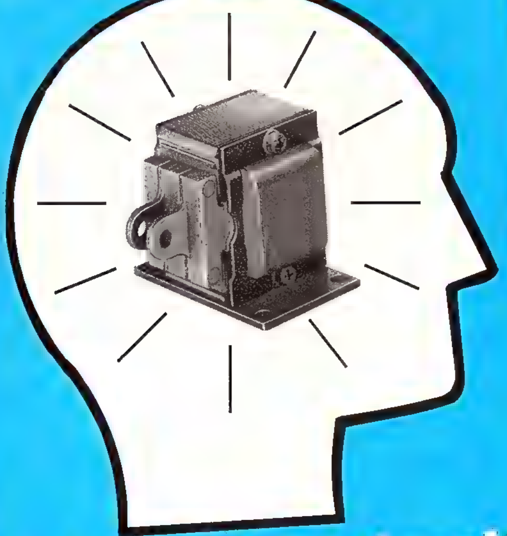

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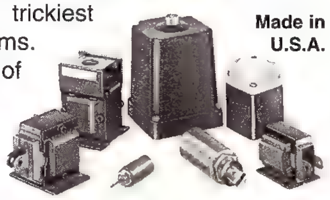

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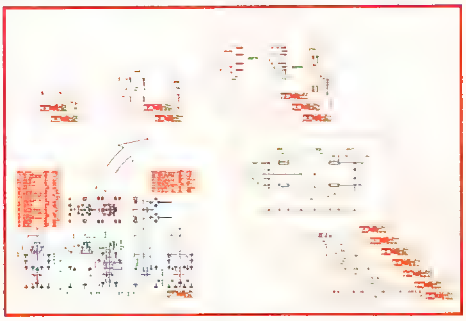

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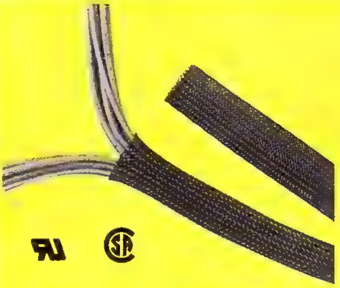

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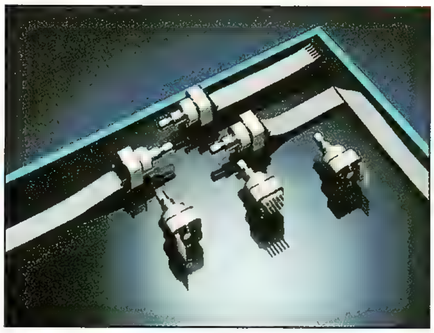


Encoder

The OE2 Series optical encoder is for tuning, menu scrolling, and selecting functions, and features a reduced overall part count. The OE2 exceeds MIL-STD 202 performance for humidity, vibration, and thermal and mechanical shocks. The encoder's positive tactile feedback targets it for use in critical applications such as medical control panels, automotive diagnostic equipment, industrial process/machinery controls, and in test and measurement equipment.

OakGrigsby Inc., 84 N. Dugan Rd., Sugar Grove, IL 60554, FAX (800) 432-9625.

For information, circle 639

Thermometers

OS520 and OS530 Series infrared thermometers feature adjustable emissivity, dual digital backlit LCD display, audible and visible alarms, five different fields of view, and analog output. Applications include non-contact temperature measurement ones with temperature range up to 2,500F.

OMEGA Engineering, Box 4047, Stamford, CT 06907, FAX (203) 359-7700.

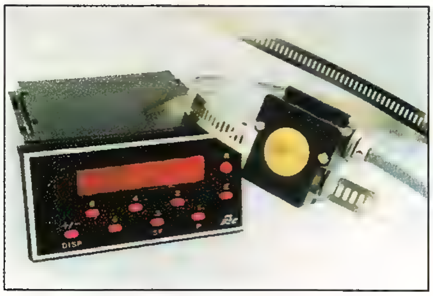
For information, circle 640

Encoder

The GHU9 "HEAVY DUTY" is a hollow-shaft encoder equipped with a cylindrical "RDI" insulating ring. The "RDI" insulating ring provides thermal and electrical isolation, and allows quick and easy assembly and disassembly of the encoder without the need for special tools. Fixing to the input shaft is achieved using a concentric locking ring at the rear of the encoder for ease of access. The MEFLEX flexible mount allows immobilization of the encoder during rotation. The MEFLEX allows an axial misalignment of up to ±3 mm, radial of up to ±0.3 mm, and angular up to ±5 degrees.

Ideacod S.A., 2, rue des Frères Lumière,, B.P.2, Z.A. Eckbolsheim, 67038 Strasbourg Cedex, France, FAX +33 3 88 76 18 65.

For information, circle 641



Linear measuring system

Meterdrive linear incremental measuring system features simplified wiring and connections and more robust circuitry. In operation, Meterdrive's stainless-steel perforated tape either passes by an opto-electronic, fixed head detector, or is suspended between two points with the detector head moving. Measurement is available to a resolution of either 0.1 or 1 mm, and can be performed at speeds of up to 10m/sec. Maximum tape length is 250m when using a fixed tape, or 10m when using the spring-loaded unit, which operates like a tape measure.

Hepco Slide Systems Ltd., Lower Moor Business Park, Tiverton Way, Tiverton, Devon EX16 6TG, England, FAX +44 1884 243399.

For information, circle 642

Accelerometers

Model SA-128R ultraminiature linear accelerometer is for general-purpose applications where small or minimal weight is of prime concern. The accelerometer is completely self-contained and requires no additional signal conditioning beyond a ±15V power source. Model SA-128R is targeted for use with dc and low-frequency dynamic measurements.

Columbia Research Laboratories Inc., 1925 MacDade Blvd., Woodlyn, PA 19094, FAX (610) 872-3882.

For information, circle 643

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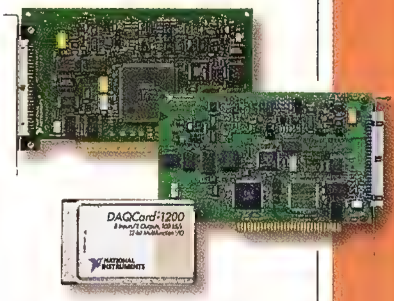

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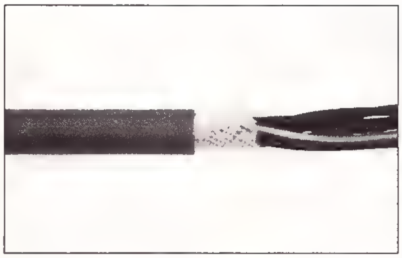

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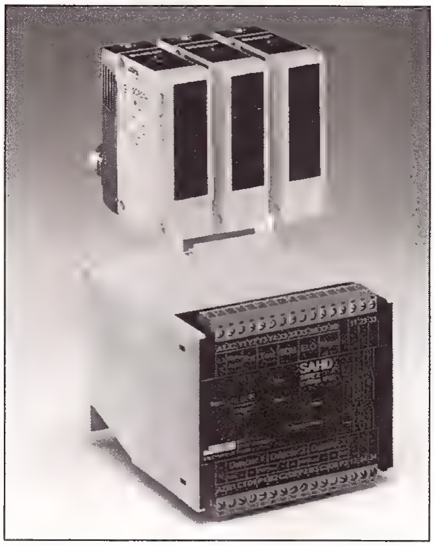
A 6 to 18 mm f/2.8 zoom lens fits straight onto ½- and ⅓-inch format TV cameras. The lens features built-in controls for zoom, aperture, and focus, and tracks and remains in focus over the whole zoom range. The lens is made for color CCTV cameras with a wave length range of 400 to 700 nm. Applications include those where small size and flexible field of view are essential. **Lens Innovation Ltd.**, England, FAX +44 02247 2114.

For information, circle 644



Safety light barrier

The SAHD safety light barrier defines a safety perimeter to protect operators working with or around dangerous machines. This can involve such working environments as a robotised installation, or access to a handling or automatic palletisation system. Equipped with one, two, or three 20m beams, depending on the variant, the SAHD safety light barrier satisfies European standards EN 50100 and EN 61496, and has been awarded a Type 2 EC examination certificate. **Jay Electronique**, 176, rue Lavoisier—BP5, F-38330 Montbonnot St. Martin, France, FAX +33 4 76 41 44 41.

For information, circle 645

Anemometer

The HHF751 digital anemometer is a versatile instrument for measuring air velocity and calculated air volume flow. Features include the ability to switch between volume flow and velocity. The HHF751 can indicate average minimum and maximum readings and includes a hold button so the display can be frozen while recording the reading. Probes are sold separately and are field-replaceable. **OMEGA Engineering Inc.**, Box 4047, Stamford, CT 06907, FAX (203) 359-7700.

For information, circle 646

Digitizer/analyzer

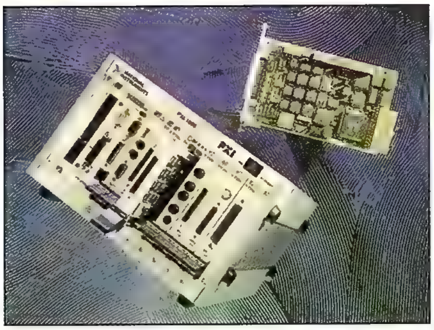
The LSA1000 *Signalyst* high-speed signal digitizer/analyzer can be integrated into data acquisition, analysis, and test systems. The LSA1000 delivers the performance of state-of-the-art digital oscilloscope technology in a compact package optimized for embedded system-integration applications. **LeCroy Corp.**, 700 Chestnut Ridge Rd., Chestnut Ridge, NY 10977.

For information, circle 647

Accelerometer

Model 7593-2 variable capacitance accelerometer offers fully signal-conditioned, low-noise output for low-level acceleration measurements. The unit is targeted for static dc and low-frequency vibration measurements. Packaged in a rugged thermoplastic case with mounting holes, the accelerometer is ready for installation in a variety of commercial and industrial environments. **Endevco Corp.**, 30700 Rancho Viejo Rd., San Juan Capistrano, CA 92675, FAX (714) 661-7231.

For information, circle 648



Modules

PXI-7314 open-loop controller and PXI-7324 closed-loop controller are fully compatible with CompactPCI and PXI specifications. The PXI stepper modules can control up to four stepper motors with fully programmable pulse and direction or clockwise/counterclockwise output signals; amplifier inhibit/enable signals; and forward, reverse, or home limit inputs per axis. Stepper control includes velocity and acceleration profiling with S-Curve acceleration boost for enhanced motion trajectory performance.

National Instruments, 6504 Bridge Point Pkwy., Austin, TX 78730, FAX (512) 794-8411.

For information, circle 649

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Lucas Aerospace, Box 457, Utica, NY 13503, FAX (315) 793-1273.

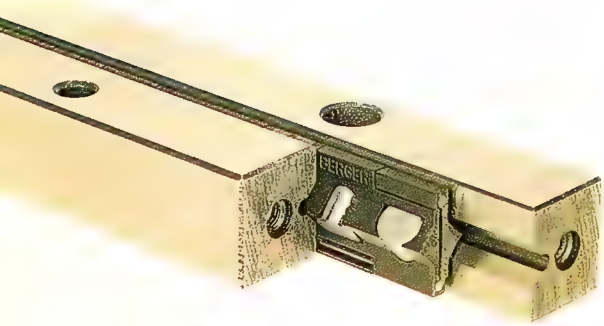
For information, circle 650

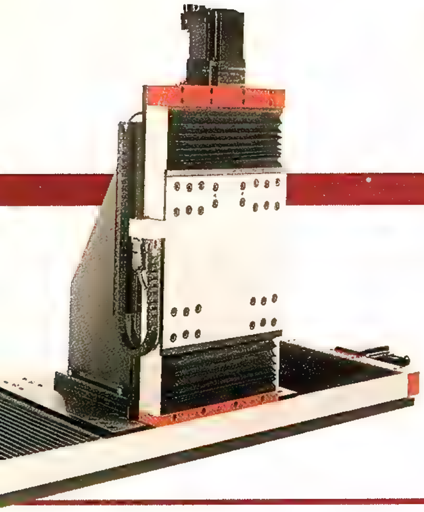
Motor

Suppressed GMRG dc motor of the 43 mm motor diameter series is excited by permanent magnets. The armature shaft rotates in both directions in sintered metal sleeve bearings. Two spade connectors with brush holder plate on the rear side are available for connection to the power supply system. Additionally, friction losses in the two-stage spur gear unit have been minimized. Applications include home automation and medical, agricultural, and mechanical engineering.

ITT Automotive Europe GmbH, Presseabteilung, Guerickestrabe 7, D-60488 Frankfurt, Germany, FAX +49 69 7603 3945.

For information, circle 651





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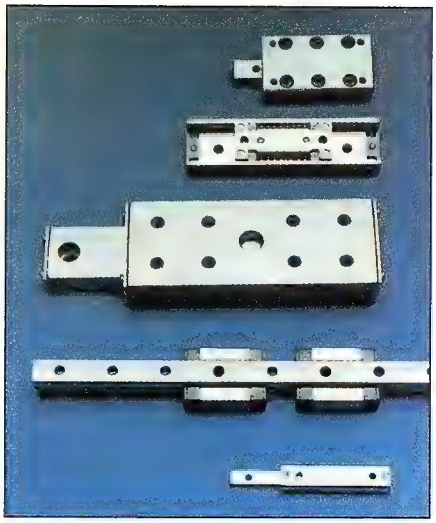


Linear slides

The RLW Series of linear slides feature a simple, two-row raceway design and ball circulation routes that provide accuracy, smooth operation, and low noise. Applications include those requiring long travel lengths such as ball and leadscrew drives. Additionally, the RBS Series is a lightweight and compact linear motion rolling guide that features a low profile, wide footprint, and stainless-steel construction. Applications include scanning or writing heads of memory storage, IC manufacturing, and inspection devices.

Reliance Gear Co. Ltd., Rowley Mills, Penistone Rd., Lepton, Huddersfield, HD8 0LE, England, FAX +44 1484 601001.

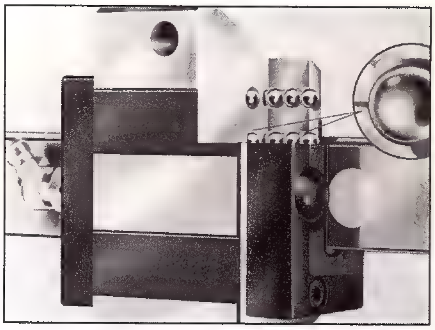
For information, circle 652

Drives

Alspa VDM range of medium-voltage drives use IGBT technology and feature a low distortion output waveform, which enables both induction and synchronous standard medium-voltage motors to be controlled directly. The drives cover a range of standard motor voltages from 2.3 to 6.6 kV with power from 800 kW to 8 MW, at frequencies up to 300 Hz. The VDM range allows users to directly control high-power, medium-voltage motors.

Cegelec, 2, quai Michelet, 92309 Levallois Peret, France, FAX +33 14 149 2578.

For information, circle 653



Guidance system

Series KUVE four-row monorail guidance system is available in carriage types for guideway sizes from 15 to 45 mm. KUVE.E is an economical variant of the KUVE linear guidance system. All cost-intensive production steps such as integral threaded holes in the saddle plate of standard and standard short carriages were deliberately omitted, as they are not absolutely necessary for normal applications.

INA Lineartechnik oHG, Schaefflerring, D-66424 Homburg, Germany.

For information, circle 654

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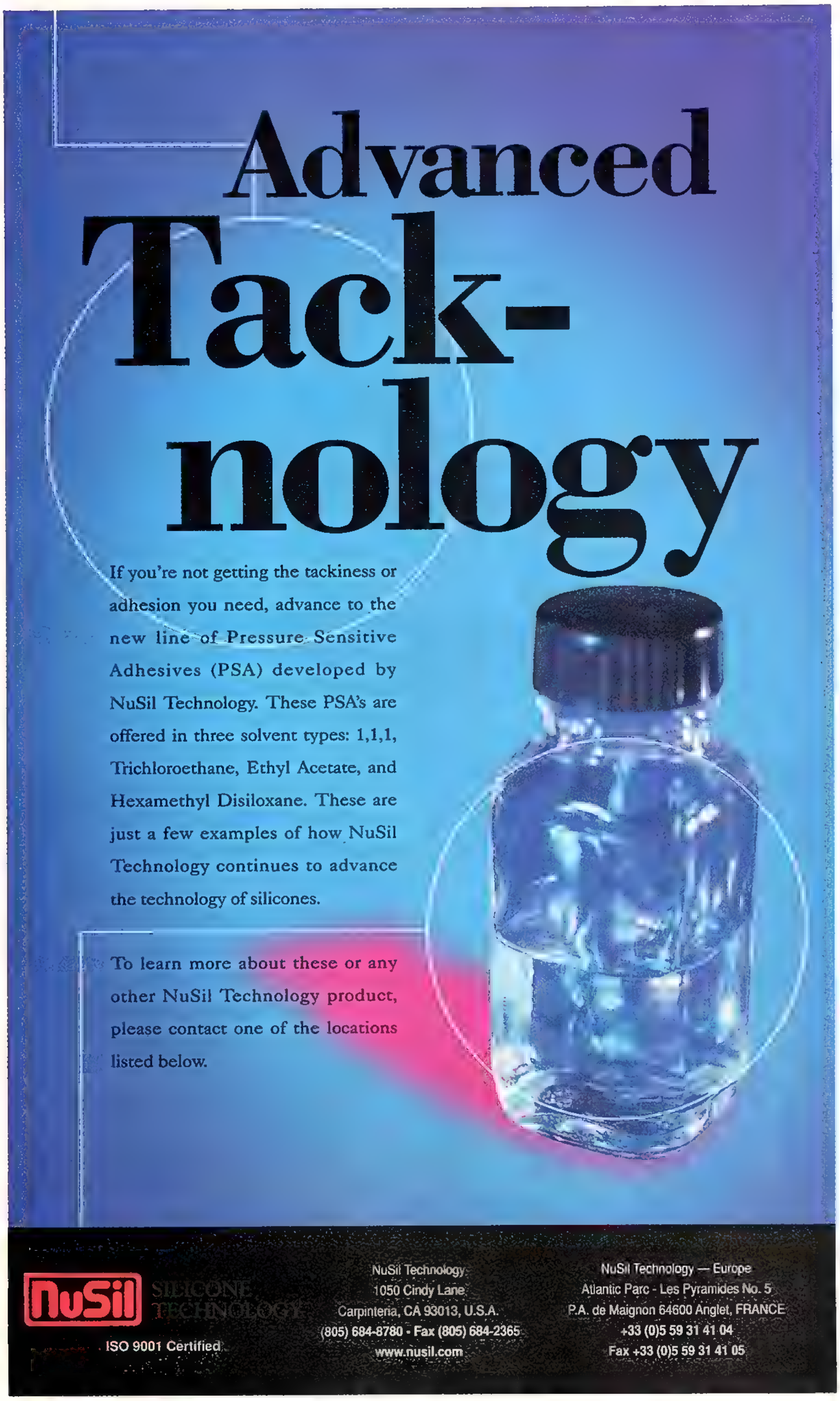
For information, circle 655



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Welding equipment

Sure Weld 20SP welding unit ultrasonically bonds nonwoven filter bags to rigid plastic circular frames, creating the bag filters used in industrial vacuum cleaners, chemical filtration devices, and swimming pools. The multi-head welding equipment operates at a production rate of up to 240 units/hr, and without consumables such as adhesives. **Sonobond Ultrasonics**, 887 South Matlack St., West Chester, PA 19382, FAX (610) 692-0674.

For information, circle 656

Open system

Han-Modular range open system allows the user to assemble his/her "own" connector to individual configuration requirements. Parts include two contact modules with screw termination for power circuits up to 40A and up to 1,000V, and one contact module with screw termination for power circuits up to 100A and up to 1,000V. **HARTING KGaA**, Box 1133, D-32325 Espelkamp.

For information, circle 657

Fastener

Model 29-1700 overcenter fastener measures 18 × 64 mm, weighs 0.028 kg, and features a breaking strength of 165 kg. The fastener can be fitted in the inverted position so any padlock will hang free with gravity. **Protex Fasteners Ltd.**, Arrow Rd., Redditch, Worcestershire B98 8PA, England, FAX +44 1527 66770.

For information, circle 658

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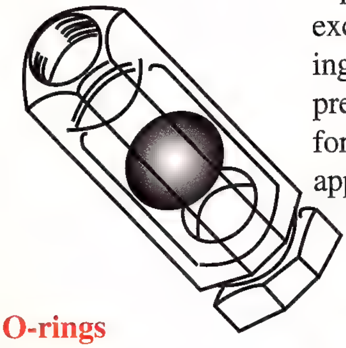

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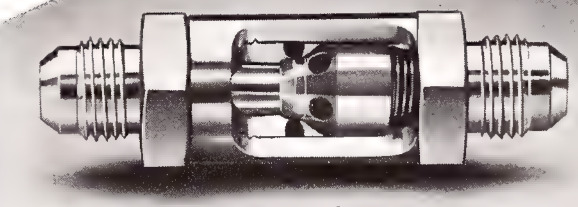

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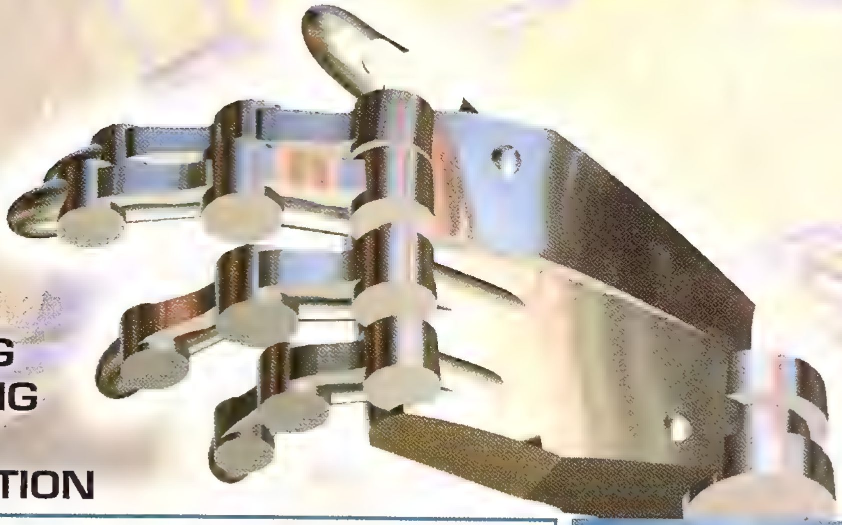

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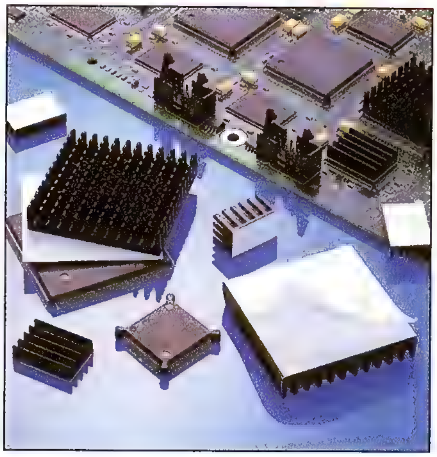
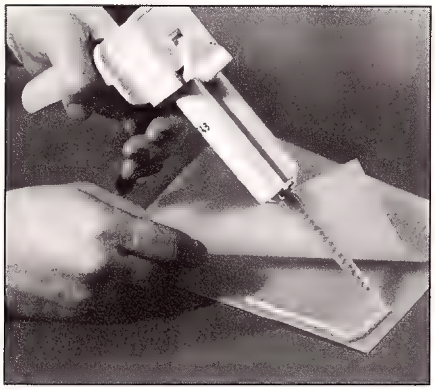


Tape

THERMATTACH® T410 thermally conductive, double-sided adhesive tape is for bonding heat sinks onto plastic IC packages. T410 thermal tape features a silicone-based, pressure-sensitive adhesive on one side of a 0.002-inch aluminum foil carrier. The tape's other side is a thermally loaded, high-bond strength acrylic pressure-sensitive adhesive that bonds securely to metal heat sinks. Applications include bonding heat sinks to molded plastic ball grid array packages and other ICs that typically dissipate from 1 to 5W of heat.

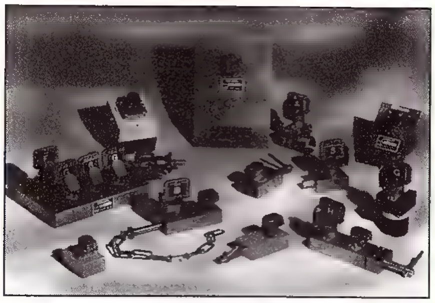
Parker Hannifin Corp., Chomerics Div., 77 Dragon Ct., Woburn, MA 01888, FAX (781) 938-0956.
For information, circle 659



Epoxy adhesive

Polymer system EP65HT-1 epoxy adhesive system cures quickly at ambient temperatures and passes stringent NASA outgassing tests. The two-component epoxy adhesive compound is readily mixed at ambient conditions and gels in eight to 10 minutes. Temperature range is to 400F. The system retains its adhesive properties, even after prolonged exposure to adverse environmental conditions such as water, solutions of acids, alkalis, and salts.

Master Bond Inc., 154 Hobart St., Hackensack, NJ 07601, FAX (201) 343-2132.
For information, circle 660



Interlocking system

Prosafe Trapped Key Interlock system features an anti-tamper mechanism for safety power interlocking in industrial safety applications. Power interlocking provides safeguarding of machines and industrial processes for applications where simple control interlocking will not eliminate an electrical, mechanical, or physical hazard. The system also provides a secure mechanical lock for hatches, gates, and doors to hazardous areas.

Scientific Technologies Inc., 6550 Dumbarton Circle, Fremont, CA 94555, FAX (510) 744-1442.
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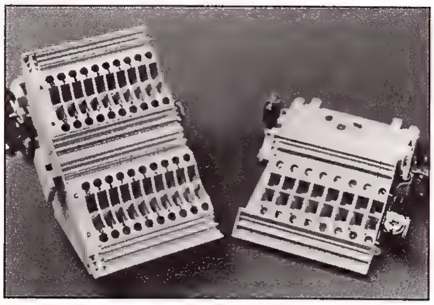

Block connectors

Terminal block connectors range from six to 64 contacts and combine the functions of terminal blocks and connectors. The connectors are for the electrical assembly and servicing of industrial and production equipment requiring a high number of flexible and accessible terminations for energy supply and control. Users can test live circuits without disconnecting either the wiring or the connector. The lower number of terminations reduces the risk of wiring errors.

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Choose from off-the-shelf and custom options ranging from 1- to 250-ton capacities. Manual or motorized operations allow precise single- and multi-point placement of everything from delicate equipment to bulky loads.

Pow-R-Jac®
A Division of Limitorque Corporation

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Call (804) 528-4400
Fax (804) 845-9736
http://www.limitorque.com/powrjac
P.O. Box 11318,
Lynchburg, VA 24506

Circle No. 257

New Metallic Seal Provides Exceptional "Springback"

Busak+Shamban has introduced the Wills Rings® C, the newest member in a full line of high-performance metallic seals.

The Wills Rings® C has an innovative C-shaped profile with springback ability up to three times greater than conventional metallic O-rings. This springback ability can compensate for hardware changes due to extreme pressure and temperature variations. These seals also feature superior static sealing performance for the most demanding applications.

The low seating load of the Wills Rings® C results in a size and weight reduction of the mating hardware. In addition, the system pressure energizes the seal profile to enhance the leak-tight seal performance. For applications requiring an extra measure of security, the Wills Rings® C can be coated with either silver or PTFE in a variety of thicknesses.

The addition of the pressure-actuated Wills Rings® C increases an already broad product line of Wills Rings® that includes solid, hollow and gas-filled metal seals. The Wills Rings® product line is the original metallic seal line used throughout the chemical, nuclear, aerospace and automotive industries where the ability to cope with extreme temperatures, pressures and media is essential.

Capabilities of the Wills Rings® includes temperatures ranging from cryogenic to 1550°F (850°C) and pressures from ultra high vacuum to 145,000 psi (1000Mpa). Leakage rates in an ultra high vacuum are below 10^{-9} cc/sec (1.01×10^{-9} mbar•liter/sec).

Busak+Shamban has provided quality, high-performance sealing and bearing solutions for over 40 years worldwide.

For further information about Wills Rings® call Pat Haggerty at 1-800-466-1727.

SEALING SOLUTIONS FOR EXTREME ENVIRONMENTS

If your application runs at high pressures, temperatures, or speeds, handles caustic media, or experiences other extreme conditions, then the Turcon® Variseal™ is your sealing solution.

The Turcon® Variseal™ is a spring-energized PTFE seal that lasts longer, seals tighter, and has lower friction than typical seals providing you with the solution you need.

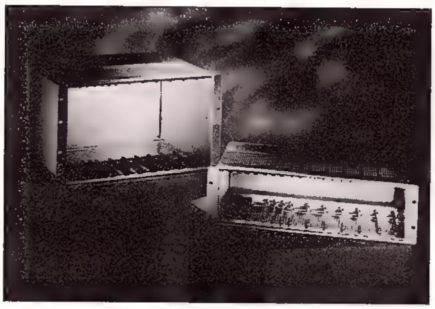
Contact us today for your free Seal Selection Guide
Call: 1-800-466-1727
Fax: 1-303-469-4874
web: www.variseal.com
www.busakshamban.com

- Pressures from vacuum to above 100,000 psi
- Temperatures ranging from cryogenic to 575°F
- Universal compatibility with aggressive media
- Low friction Turcon® with a friction coef. C_f=.05-.10
- Ideal for running dry; no lubrication required
- Multiple spring loads to meet your exact force and torque requirements

Busak+Shamban

Variseal™ is manufactured within the Busak+Shamban Group by American Variseal

Circle No. 259



Subrack

KM6-RF subrack provides EMC shielding for electronics that operate in the high end of the frequency spectrum. The subrack features an extruded EMC front panel and contact fingers, which minimize intrusion into the PCB area. A finger strip that fits to the front extrusion and further enhances the screening level of the panels, particularly on the wider versions, is available to interface with the panels.
VERO Electronics Inc., 5 Sterling Dr., Wallingford, CT 06492, FAX (203) 949-1101.
For information, circle 663

Extrusion

MiniTec® modular aluminum framing system for custom construction is for framing with tear-open T-slots. The G style extrusion is for general engineered structures in the food, medical, and clean room industries, or anywhere strict hygiene standards must be maintained. The extrusion eliminates plastic or metal covers commonly used to seal the standard extrusion T-slot. Applications include custom machine guards, bases, enclosures, workstations, automated test stations, prototypes, and linear motion.
Velmex Inc., 7550 State Rte. 5 & 20, Bloomfield, NY 14469, FAX (716) 657-6153.
For information, circle 664

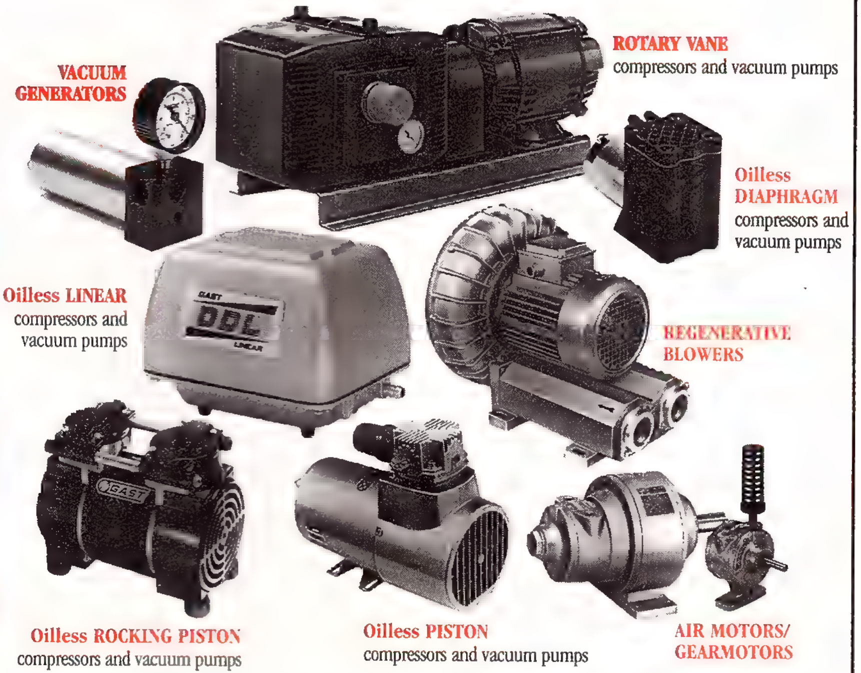
Markers

Series 300 Scribers for marking metal labels are for benchtop applications and mark in a range of character sizes, styles, and configurations. The markers can also do multiple lines of text on tags or labels of different materials such as aluminum, brass, and steel. Changeover for a different tag involves calling up a new part number on a PC.
Borries Marking Systems, 3135 S. State St., Ann Arbor, MI 48108, FAX (734) 761-1171.
For information, circle 665

Why Gast for your pneumatic components?

More Choices Mean Superior Solutions

Simply stated, nobody offers more standard pneumatic components than Gast. And nobody offers more experience in matching pneumatic components to specific applications...or in custom engineering products if that's the best solution. Here's a brief overview of the largest product selection in the industry.


VACUUM GENERATORS
ROTARY VANE compressors and vacuum pumps
Oilless DIAPHRAGM compressors and vacuum pumps
Oilless LINEAR compressors and vacuum pumps
REGENERATIVE BLOWERS
Oilless ROCKING PISTON compressors and vacuum pumps
Oilless PISTON compressors and vacuum pumps
AIR MOTORS/ GEARMOTORS

Also consider Gast enjoys the reputation as the highest quality pneumatic component supplier. Gast has achieved ISO 9001 Certification to further assure your confidence of receiving the highest value pneumatic components, as well as the optimum pneumatic solution. Many offerings comply with the European Community's Machinery Directive. Contact your Gast Representative/Distributor for information on specific models.

For literature or name of local distributor (U.S.A. only) phone 1-800-952-4278 or Fax 1-800-771-8349, International response fax 1-616-926-1817.

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IDEX
IDEX CORPORATION

Circle No. 260

If leaks don't bother you, that's your business . . . If they do, that's *our business!*

More Sealing Solutions

The Parker Hannifin Seal Group is a leading global supplier of sealing devices, sealing systems, EMI shielding and thermal management systems.

The diverse sealing products manufactured by Parker include O-rings, hydraulic and pneumatic seals, metal-bonded-to-rubber Gask-O-Seals and Integral Seals, fastener and fitting seals, PTFE rotary seals and EMI shielding products.

Parker Seal offers the world's widest range of hydraulic and pneumatic piston and rod seals in both standard inch and metric sizes - Literally thousands of different combinations of materials and seal profiles in all.

Local Products & Service

Over 130 highly qualified Parker Seal Distributors are located throughout the United States and Canada providing fast local service and *genuine* Parker Seals.

inPHorm™ Seal Design and Material Selection Software

Five different *inPHorm* Seal Design and Material Selection software packages are now available to assist in seal design and material evaluation. *inPHorm* provides gland and seal dimensions, material recommendations, test reports and other helpful seal data in inch or metric format.

inPHorm
PolyPak Design and Material Selection Software
inPHorm
O-ring Design and Material Selection Software

Global Availability

Parker Seal has manufacturing plants an engineering/sales facilities in Germany, Italy, Denmark, Great Britain, Argentina, Brazil, Mexico, Spain and the Czech Republic. This global presence assures our multinational customers of a reliable source for high-quality sealing devices.

To compliment and support Parker's global manufacturing capability, there are over 270 Parker distributors serving loca customers in Latin America, Europe, Asia, the Middle East and the Pacific Ri

Want More Information?

To obtain a free copy of Parker's 16 page "Sealing Solutions Guide", or for specific information and system requirements on any of Parker's *inPHorm* Software for sea design, simply contact your nearest loca Authorized Parker Seal Distributor or call 1-800-C-PARKER. *We're here to help!*

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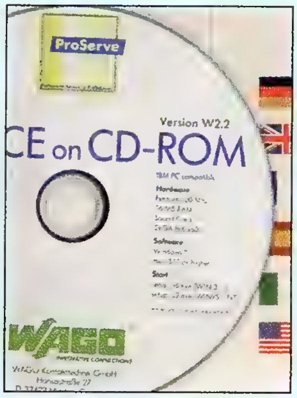
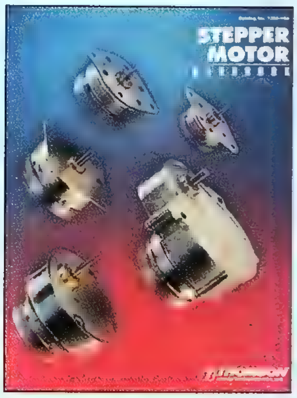
Parker Seal

Circle No. 261



Circle 666



Circle 667

Circle 668

Circle 669

CD-ROM

Service on CD-ROM catalog W2.2 is available as a 32- or 16-bit version, where the 32-bit allows use of all options and the 16-bit is limited to the W2.1 options. New options include a multi-connection system for assigning male connectors to female connectors and vice versa, and the ability to configure completely assembled fieldbus nodes and create AUTOCAD DXF files and marker cards.
WAGO Corp., 9085 N. Deerbrook Trail, Brown Deer, WI 53223, FAX (414) 354-1268
For information, circle 666

Stepper motor

Permanent-magnet stepper and gear motors range from 15- to 60-mm in diameter, provide step angles of 1.8 and 3.6 degrees (hybrids), and 3.6, 7.5, 15, and 18 degrees (permanent magnet). Both motors come in standard industry configurations for drop-in replacement. *Stepper Motor Handbook* includes specification sheets, a quick reference chart, and a tutorial on stepper motor technology. In addition, application notes, formulas, and terminology are included.
Thomson Industries Inc., 2 Channel Dr., Port Washington, NY 11050, FAX (516) 883-9039
For information, circle 667

Sensors

CD-ROM Type 2891 provides 2D (DXF) and 3D (IGES) drawings of sensors and associated accessories for plastics processing. Files copied into the appropriate directory of the CAD system can be imported, and by using the mouse, users can directly insert the cavity-pressure sensors at the required spot in the mold drawing. The CD-ROM also describes the company's measuring technique in the HTML format. This includes a product description and technical data.
Kistler Instruments AG Winterthur, Eulachstrasse 22, Box 304, CH-8408 Winterthur, Switzerland, FAX +41 52 224 1414.
For information, circle 668

Linear guidance systems

Publication LIF *Linear Guidance Systems* covers guidance elements for processing machinery and handling equipment. The publication also includes information on product groups such as linear roller bearing and guideway assemblies; six- four-, and two-row linear ball bearing and guideway assemblies; linear ball-bearing units; and track-roller linear and shaft guidance systems. Publication LIF also provides the reader with information on general technical principles such as operating limits, load-carrying capacity and life, friction, lubrication, and accuracy.
INA Lineartechnik oHG, Schaefflerring, D-66424, Homburg (Saar), Germany, FAX +49 6841 70111.
For information, circle 669

Tracking system

Independently Steerable Pulley (ISP) is for tracking and steering designs with continuous, intermittent, or reversing motion profiles. The pulley can be engineered in Solid Round, I-Beam, C-Section, or Capped-Tube configurations with a 24-inch maximum fax width. Brochure provides technical data on the ISP and explains two types of system configurations. Design options are also detailed.
Belt Technologies Inc., 11 Bowles Rd., Agawam, MA 01001, FAX (516) 435-1612.
For information, circle 670

Stepper/servomotor brakes

Front-end stepper/servomotor brakes feature high torque in a "failsafe" permanent-magnet brake design. When the power is off, the brake is on. The brakes' plug-in design incorporates a torsionally rigid coupling which accepts misalignment. True NEMA 23, 34, and 42 sizes are available in both 24 and 90V dc. Catalog #SSB-1 offers photographs, drawings, dimensional specifications, and technical data on stepper/servomotor brakes.
Electroid Co., 45 Fadem Rd., Springfield, NJ 07081, FAX (973) 467-2606.
For information, circle 671

Test equipment

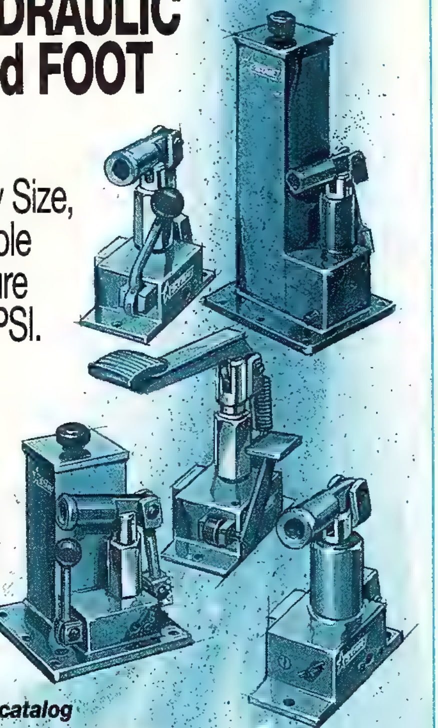
Tools, tool kits, cases, and test equipment are for telecom, LAN, fiber optic, wireless, medical electronic, and computer industries. Spring 98 catalog includes a computer-testing section featuring benchtop test equipment, and EEPROM and SIMM testers. The Telecom section features bit-error rate testers, digit grabbers, digital butt sets, and transmission test sets.
Specialized Products Co., 1100 S. Kimball Ave., Southlake, TX 76092, FAX (817) 329-6647.
For information, circle 672

Linear motor

Lightning Series moving-magnet no-steel (MM-NS) linear motor is made of a moving-magnet assembly with no attached cables. Brochure includes a product description and explains product advantages and principle of operation. A chart lists motor specification, and a coil and magnet assembly outline are also provided.
Anorad Corp., 110 Oser Ave., Hauppauge, NY 11788, FAX (516) 435-1612.
For information, circle 673

STAR HYDRAULIC HAND and FOOT PUMPS

Any Style, Any Size, Single or Double Acting, Pressure up to 20,000 PSI.



Star offers the most complete line of standard pumps available, but if you can't find a standard pump to meet your requirements, Star will design and build a special pump for your application.

Phone or FAX for catalog
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2727 CLINTON ST., RIVER GROVE, IL 60171-1598

Circle No. 262

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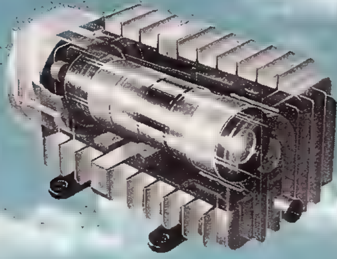
THE SOURCE FOR LOW TO MID PRESSURE RANGE AIR PUMPS.



The sky's the limit. When it comes to low to medium pressure applications, Medo has more vacuum pumps and air compressors to meet your needs. To learn more about how you can maximize your OEM designs with Medo, give us a call.

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• 4525 TURNBERRY DRIVE, HANOVER PARK, IL 60103 •

Circle No. 263

Pre-engineered turntable bearings *from stock*

Now you can get a turntable bearing for medium duty applications...*FROM STOCK.* Kaydon's K-Series bearings provide a cost effective solution for applications such as small cranes, booms, and lifts; aerial towers and ladders; industrial positioners and rotary tables; rotating displays; robotics; material handling equipment and conveyors.

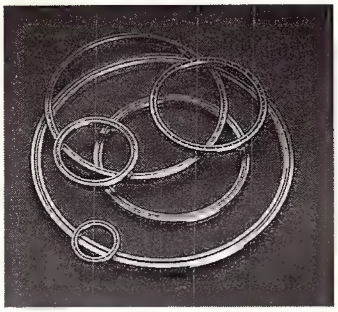
Standard bolt holes make mounting easy. Available in sizes up to 48" O.D. with internal gear, external gear, and non-geared configurations. For moment loads to 140,000 ft. lbs. Matching pinions also from stock.

Request a free copy of the K-Series catalog and REALI-DESIGN™ II specification software. Kaydon Corporation, 2860 McCracken St., Muskegon, MI 49441-3495. Phone (616) 755-3741. For fastest response fax (616) 759-4102.

Circle 264 for catalog. **Circle 265 for software.**

KAYDON BEARINGS

REALI-SLIM bearings save weight and space



Kaydon REALI-SLIM® thin-section bearings are the industry standard for compact, weight-saving power transmission designs. They're excellent for radar, machine tools, mobile equipment, instruments, automation and robotics, material handling, medical, and other precision applications. Available from stock in 1" to 40" bore sizes, and 8 different cross sections from 3/16" to 1". Choose from radial contact (Type C), angular contact (Type A) and four-point contact (Type X) geometries. Double-sealed, special coatings and customizing also available.

Request a free 64-page catalog and REALI-DESIGN™ I software to help you specify thin-section bearings quickly and accurately. Kaydon Corporation, 2860 McCracken Ave., Muskegon MI 49443. Telephone 616-755-3741. For fastest response Fax: 616-759-4102.

Circle 292 for catalog 300. **Circle 293 for design aid software.**

KAYDON BEARINGS

Software

Spring NCsimul software allows users to achieve complete simulation of the tasks their machines perform. Applications include use in the aerospace and automotive industries. Brochure provides information on the benefits of using NCsimul and explains intuitive operational interfaces and features. A section explains the simulation process, and another provides application/user examples.

Spring Technologies Inc., 1901 North Roselle Rd., Suite 300, Schaumburg, IL 60195, FAX (847) 490-6421.

For information, circle 674

Clamping system

The easylock® II fast-action clamping system provides the shortest, possible roll change-over for supply rolls and spools. The system's modular design allows for simple, single-handed adaptation without the use of tools. Brochure 30de explains how the unit operates and includes dimensions on pintle points available in both metric and fractional inch sizes.

Amacoil Inc., Box 2228, Aston, PA 19014, FAX (610) 485-2357.

For information, circle 675

Surface coating

NEDOX® surface coating can be applied to different ferrous and nonferrous metals, including aluminum. Brochure provides new engineering and technical data. Tables include the equilibrium wear rates, salt-spray test results, a friction chart, comparison with chromium plating, and special characteristics of different NEDOX formulations. In addition, photographs illustrate NEDOX at work in different industrial situations.

General Magnaplate Corp., 1331 Rte. 1, Linden, NJ 07036, FAX (908) 862-6110.

For information, circle 676

Sensor

Uprox proximity sensor has a stainless-steel housing and sensing face. Brochure details product features and benefits and includes a selection guide. For each model, a wiring diagram, selection chart, specifications, and dimensions are provided. An index is also included to help users locate a specific model.

Interlink BT, 3000 Campus Dr., Minneapolis, MN 55441, FAX (612) 694-2399.

For information, circle 677

Drill bushings

Metric drill bushings feature a no-counterbore design that permits more-precise hole drilling because the bearing surface supports the drill for the entire bushing length. Bushings are also thru-hardened at 62 to 64 R_c for a longer service life. Brochure provides detailed descriptions of plain- and head-press fit, and slip-fixed renewable bushings. Information on plain- and head-liners is also included.

Acme Industrial Co., 441 Maple Ave., Carpentersville, IL 60110, FAX (847) 428-1820.

For information, circle 678

Injection molding

Brochure describes a company's European custom injection-molding operations. The company has additional capabilities to provide assembly and packaging services, all within ISO 9002 guidelines. Applications for this service include use in the automotive, electronic, electrical, and medical industries.

Plastic Molding Technology Inc., Silvermine Industrial Park, 92 Cogwheel Lane, Seymour, CT 06483.

For information, circle 679

FULL LINE OF OEM FLUID HANDLING PUMPS

Bellows metering pump

Corrosion and chemical resistant. Single or tandem models. Accurate to +/- .5%. Self-priming. No seals. Can run dry. Flows from 1.9 ml/min to 5200 ml/min.

Compact & mini bellows pump

Self-priming metering pumps, accurate to +/- .75%. Flow rates to 324 ml/min (mini) and 945 ml/min (compact). Discharge pressures to 5 psi. Economical. Tandem models available.

Oscillating pump

Self-priming to 48 inches. Corrosion-resistant. No seals. Flows to 1.2 gpm with discharge heads to 8.3 feet. FDA accepted materials. Economical.

Magnetic drive pump

Dry run capability, corrosion resistant. Flows to 35 gpm. Discharge heads to 53 feet. Hydraulically efficient.

Centrifugal pump

Flows to 60 gpm and discharge heads to 84 feet. Pumps handle everything from corrosive chemicals to small solids. Efficient and economical.

Nutating pump

High-pressure, corrosion resistant, plastic molded construction. Flows to 4.2 gpm. Self-priming. Self-adjusting pressure limit. No valves or moving seals.

Peristaltic pump

Low cost pumps for handling corrosive solutions. Self-priming to 20', no seals. Flows from 7 to 350 ml/min. Thermally protected gear motors standard.

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DIVISION OF THE GORMAN-RUPP COMPANY
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High quality. Dependable service. Competitively priced.

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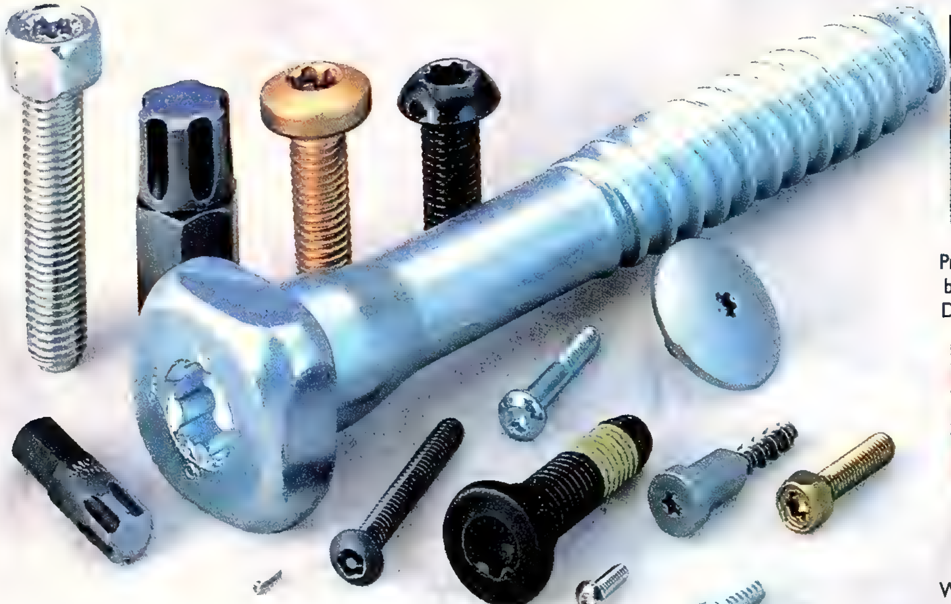
We said the TORX PLUS® Drive System was better. Our customers proved it.



You've heard the pitch–"our product is better than anything on the market." And, quite honestly, we think our TORX PLUS® Drive System for fasteners is better than anything else on the market. But, how can you be sure?

Well, first we tested it and discovered some pretty startling results:

- 100% improvement in driver bit life minimizes costly down time for tooling changes;
- 25% average increase in drive tool torsional strength allows increases in seating torque values;
- Longer drive bit life to lower tooling costs; and
- 0° drive angle ensures optimum torque transfer.

And we already knew it would reduce camout and tool slippage, lower end load requirements and reduce worker fatigue.

When combined with the AUTOSERT® feature for high RPM engagement, the TORX PLUS Drive offers even higher line productivity.

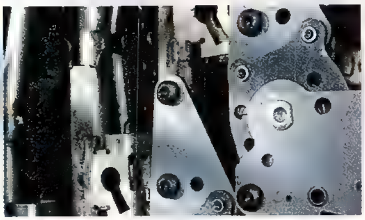
But the real test isn't in the lab. It's on our customers' assembly lines. And, actually, their results were better than ours.

From automobiles to electronics, the TORX PLUS Drive System is improving productivity and lowering in-place costs.

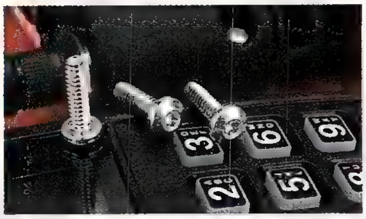
To realize the benefits of the TORX PLUS Drive System on your assembly line, call us at:

1-800-544-6117

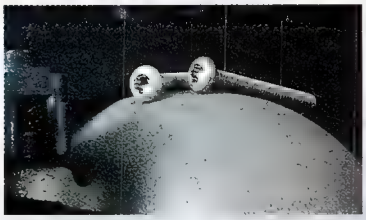
CAMCAR TEXTRON
Camcar Division of Textron Inc.



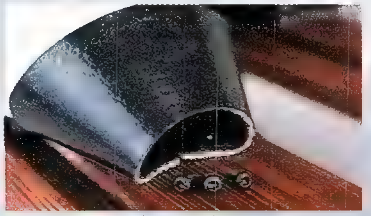
Automotive Seating
Prior to using TORX PLUS fasteners, broken drive bits caused excessive line stoppage. TORX PLUS Drive improved bit life to reduce line shut downs.



Cellular Phones
With TORX PLUS Drive and the Autosert feature, the robotic assembly equipment engages the recess faster with less damage to the bit and recess.



Automotive Emission Control System
Even at high torque levels, the TORX PLUS Drive allowed a 400% increase in the number of fasteners driven per drive tool for more assembly line uptime.



Exercise Equipment
Using Phillips drive fasteners, bit usage averaged 75 per day. With TORX PLUS fasteners they're using 2 per day, saving $2,500 a week in drive bits.

Truck Trailer
By converting to the Autosert feature, installation time was reduced 15-20 minutes per trailer and drive bit usage was reduced by nearly 90%.

Rockford, IL • Belvidere, IL • Decorah, IA • Rochester, IN • Spencer, TN • Girard, OH • Elk Creek, VA • Wytheville, VA • Ontario, Canada • Neuwied, Germany • Singapore • Mexico
TORX PLUS® and AUTOSERT® are registered trademarks of Camcar Division of Textron Inc.

Circle No. 267 or visit www.instant1.com/dn.80701.1004

PLL

TRU-050 quart-stabilized PLL for applications up to 65 Mbytes/sec performs clock recovery and data retiming, frequency translation, and clock smoothing. *Complete PLL Solution* brochure is for engineers involved in VCXO or PLL designs; or any frequency translation, clock smoothing or recovery, and data retiming applications. The brochure includes specification data and application notes graphically depicted with simulated results including spice models and block diagrams for clarification.

Vectron Int'l, 166 Glover Ave., Norwalk, CT 06856, FAX (888) 329 832-8766.
For information, circle 680

Couplings

SC swing couplings allow unrestricted full flow with safe connection and disconnection under pressure. Couplings interchange with most common plug systems, providing a universal and flexible connection. Brochure provides product information and includes a material and compatibility chart and flow diagram. For each coupling series diagrams and specifications are provided. Other sections in the brochure provide application information, and describe seals, materials, and lubricants.

Oetiker Inc., Box 93, Livingston, NJ 07039, FAX (973) 533-1826.
For information, circle 681

Bearings

Data Item No. 96015 *Design and Material Selection for Dry Rubbing Bearings* describes the use of computer program A9615 for selecting materials for dry-rubbing bearing applications, including aircraft undercarriage bearings. Data item describes the preparation of input data for the computer program and also illustrates the interpretation of the output through application examples.

ESDU Int'l plc, 27 Corsham St., London N1 6UA, England, FAX +44 0171 490 2701.
For information, circle 682

Metric shaft collar/coupling

Catalog provides information on Nomar® collars and couplings, which wrap around the shaft to produce an even distribution of clamping forces without the shaft damage caused by set-screws. Products include the full-metric Nomar® one- and two-piece clamp-style shaft collars; Nomar® one- and two-piece straight, and step-bore rigid couplings; and zero-backlash Flexbeam™ flexible couplings.

Ruland Mfg. Co. Inc., 380 Pleasant St., Watertown, MA 02172, FAX (617) 924-9205.
For information, circle 683

Heat-transfer fluid

Paratherm OR™ heat-transfer fluid controls process temperatures in closed-loop, liquid-phase heat-transfer systems up to 600F. This heat-transfer fluid is non-fouling and will not coat the system's heated surfaces with hard, baked-on carbon deposits when severely overheated. Technical bulletin includes product data; information on thermal oil systems; and addresses concerns such as human, environmental, and system safety.

Paratherm Corp., 1050 Colwell Rd., Conshohocken, PA 19428, FAX (610) 941-9191.
For information, circle 684

Before IKS Bearings get to you… they have to get through them

Each bearing that arrives at IKS from our Japanese and Chinese factories is put through a vigorous final assembly and inspection procedure. Our U.S. final assembly capability offers IKS customers the flexibility to specify a wide range of bearing packing greases including high temperature and food grade grease. An in-house laser marking capability allows for customer specified identification and numbering. Finally, all standard and stainless steel bearings are thoroughly tested for noise, radial clearance, and SQC procedures.

No matter what your bearing requirements, even small quantities, IKS provides cost competitive ball bearings you can trust. Remember bearings that don't meet IKS standards don't even show up, they wouldn't dare!

For more specific information call today.

IKS BALL BEARINGS

IKS American Corporation
1555 W. Rosecrans Avenue
Gardena, CA 90249
Toll Free (800) 421-2761
Tel: (310) 329-1800
FAX: (310) 324-4005

Circle No. 268

Linear guides

Catalog features information on 17 types of RoundRail and ProfileRail linear guides , including linear guides with different contact technologies, mounting types, and mounting styles. These linear guides are for applications from cleanroom environments for semiconductor wafer processing equipment to harsh and contaminated environments for machine tools. Other applications include component pick-and-place systems, medical and test equipment, packaging machines, and electronic component handling equipment.
Thomson Industries Inc., 2 Channel Dr., Port Washington, NY 11050, FAX +1 516 883 9039
For information, circle 685

Fuses

Republic Series Adjustable Velocity Fuses (AVF) provide automatic hydraulic line rupture shut-off and can isolate a problem circuit on parallel-circuit applications. Bulletin No. 3000-B1/USA contains product information and features and a fuse operation-description. Specifications, dimensional data, and closing flow adjustment ranges are included, along with application information and circuit drawings.
Parker Hannifin Corp., Sales Lead Management Service, M.S. 2212, 17325 Euclid Ave., Cleveland, OH 44112.
For information, circle 686

Miniature fittings

M3, M5, and M6 threaded fittings are for applications including semiconductor production machinery, medical equipment, and robotics. Catalog describes O-ring face seal fittings, valves, quick disconnects, tubing, pressure regulators, and cylinders. The O-ring design reduces operating costs by preventing compressed-air losses and insures reliable operation of the pneumatic circuit.
Cotelco s.r.l., Via Cassanese, 203/5, 20090 Segrate, Milano, Italy, FAX +39 2 26922484.
For information, circle 687

Isolators/mounts

Catalog provides information on shock and vibration isolators and mounts. Featured products include machinery, bonded tube, cup-style, high deflection, low profile, and cylindrical stud mounts. The isolator line includes ring and bushings; ball, cable, V, engine, and Navy mounts; casters; and suspension pins. An isolator selection guide is included. Each product description includes features, benefits, load ranges, applications, dimensions, and performance data.
Barry Controls, 40 Guest St., Brighton, MA 02135, FAX (617) 782-8140.
For information, circle 688

Brushless servomotors

PACTORQ Series brushless servomotors use an optimized magnetic circuit design to produce high torque in relatively small NEMA frame sizes. Selection guide provides performance details, technical specifications, and model number codes. The guide also describes the motors' ratings, characteristics, and dimensions; and performance, continuous power, and efficiency curves.
Pacific Scientific, Automation Technology Group, Box 2650, Rock Hill, SC 2973, FAX (803) 328-1870.
For information, circle 689

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Circle No. 269

TOOLING COMPONENTS

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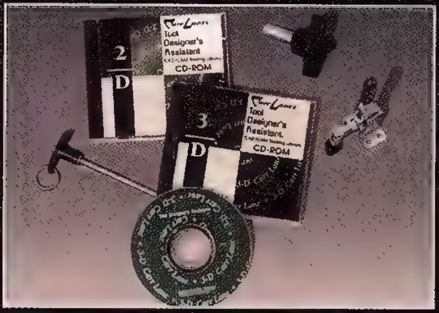
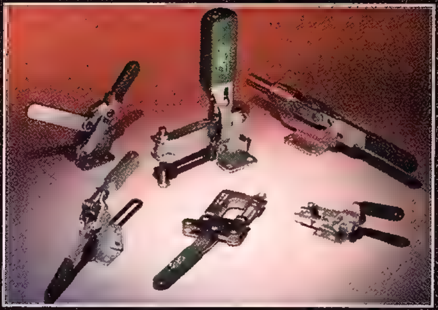


CAD/CAM TOOLING LIBRARY

Need design assistance? Carr Lane's CAD/CAM tooling library contains over 7,800 full-scale drawings of jig and fixture components to speed fixturing design. Select 2-D or 3-D versions, on CD-ROM or diskettes.

Circle No. 295



TOGGLE CLAMPS

Losing your grip? Toggle clamps from Carr Lane are the "universal" workholder. Choose from hold-down, push/pull and latch-action types. New options include heavy-duty clamps, toggle pliers and automatic models.

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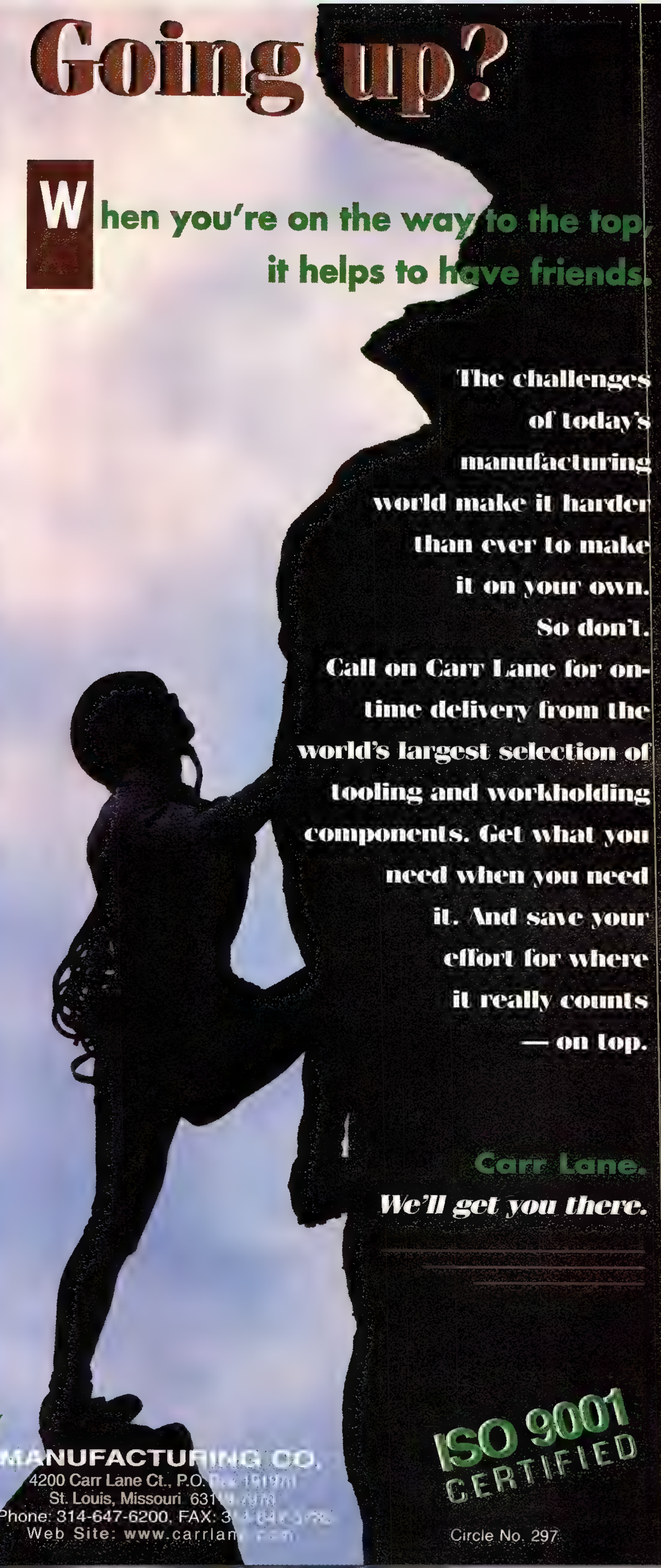

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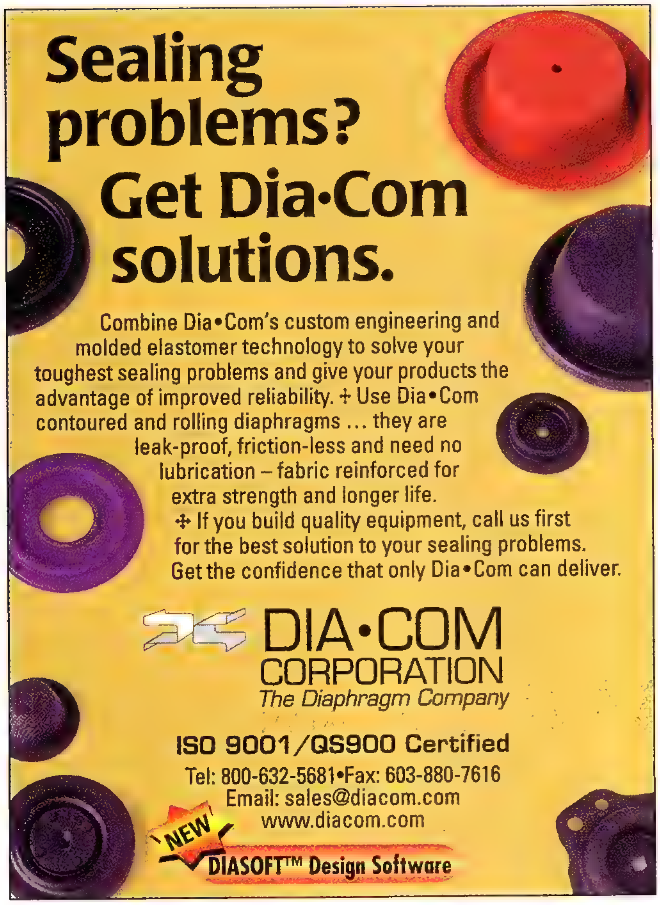

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Circle No. 274

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Buffer

Model 921E multichannel buffer is for applications including nuclear spectroscopy. Functions include a digital spectrum stabilizer and nonvolatile data memory. Technical bulletin provides a product description, photograph, and block diagram. A section lists product information separated according to performance, front-panel indicators, controls, inputs, outputs, interfaces, and electrical and mechanical specifications.

EG&G ORTEC, 100 Midland Rd., Oak Ridge, TN 37831.

For information, circle . . . . **.690**

Chains

Rex®, TableTop®, and MatTop® chains are for industrial product-handling applications. Rex chains are for use in the automotive, cosmetic, pharmaceutical, and appliance industries, and other unit-handling operations.

Rexnord Corp., Plastics Div., 1272 Dakota Dr., FAX (414) 376-4720.

For information, circle . . . . **.691**

Fasteners

PEM® KEYHOLE® self-clinching standoff fasteners enable a pc-board or panel to be quickly slipped into place and then removed from an assembly by sliding the board sideways and lifting it off. Fasteners are for spacing or hanging replaceable components, and are available in different lengths for installation in sheets as thin as 0.04 inches/1 mm. Bulletin SK provides specifications, performance data, and installation procedures.

Penn Engineering & Mfg. Corp., Box 1000, Danboro, PA18916, FAX (215) 766-0143.

For information, circle . . . . **.692**

Air filters

FSG filters for general-purpose air systems feature a cast head and spin-on canister design, and are similar to an automotive filter in appearance. Brochure contains information on four filtration grades—Bulk Liquid, Coalescing, Course Coalescing/Particulate, and Charcoal Element Vapor filter. It also outlines applications where maximum performance can be achieved with each.

Gardner Denver Machinery Inc., Box 4024, Quincy, IL 62305, FAX (217) 223-5897.

For information, circle . . . . **.693**

Powerline filters

Catalog on three-phase powerline filters features components from 3 to 1,200A. The catalog is available in English, French, and German, and is targeted for commissioning personnel and designers seeking EMC project solutions. Technical information and component performance characteristics are provided for various models of off-the-shelf, three-phase powerline filters.

Wordsun Ltd., The Old Post Office, Gaunt's Common, Wimborne, Dorset BH21 4JN, England, FAX +44 1258 840960.

For information, circle . . . . **.694**

Synthetic lubricants

Synthetic Lubricants for Compressors brochure reviews requirements for compressor lubricants and summarizes test results for different grades of both synthetic diester-based and hydrocarbon-based compressor lubricant products. The literature recaps data to demonstrate benefits such as a reduction in energy costs, extension of oil-drain intervals, and decreases in deposits of varnish and sludge, among others.

Anderol Co., 215 Merry Lane, East Hanover, NJ 07936, FAX (973) 884-3825

For information, circle . . . . **.695**

Bearing components

CERBEC® bearing components provide extended life and high performance under demanding conditions such as high speed and acceleration, high temperature, corrosion, and marginal lubrication. Brochure describes products created by this company from materials such as oxides, nitrides, and carbides. Sections include application examples such as engine components, seals, and bearing components.

Norton Advanced Ceramics, 10 Airport Park Rd., East Granby, CT 06026, FAX (860) 653-6834.

For information, circle 696

Circuit products

Selection guide features product specifications, mechanical dimensions, and approval information for circuit products, reed relays, surge protection devices, and advanced magnetic products. Circuit products include relays, switches, optocouplers, integrated products and data-access arrangement modules. Reed relay products feature dry and wetted reed relays. Surge protection devices offer transient voltage suppression components, and advanced magnetic products range from small coil windings to magnetic subassemblies including solenoids.

CP Clare Corp., 78 Cherry Hill Dr., Beverly, MA 01915, FAX (978) 524-4700.

For information, circle 697

Cutting systems

Modular M-Line cutting systems digitally cut and mill products including a membrane switch, film and plastic components, and gaskets. M-800, M-1200, and M-1600 models feature a working width of 1,300 mm and are available in various lengths. *Precision Systems for Industrial Manufacturing and Product Development Applications* brochure includes inserts on using the cutting systems for label, decal, and membrane switch applications.

Miltec Corp., Box 10125, Erie, PA 16514, FAX (814) 825-7244.

For information, circle 698

Diaphragm valves

Dia-Flo diaphragm valves feature bubble-tight shut-off, isolated bonnets, and adjustable travel spots. Applications include use in the chemical, water treatment, power, mining, pharmaceutical, and electronics industries. Catalog features product descriptions, technical data, and engineering schematics of Dia-Flo Weir, Solid Plastic, Straightway, Actuated, and Dualrange® Diaphragm valves, plus a complete review of available diaphragms.

ITT Engineered Valves, Box 6164, Lancaster, PA 17603, FAX (717) 291-2025.

For information, circle 699

Motors/drives

Motion drive catalog provides information on Vector Drives®, Servo Drives, and MINT™ motion control products. The catalog is divided into sections, the first providing an overview of products available for motion control applications. In addition, MINT motion controllers, operator interfaces, and programming software are introduced. The second section defines MINT technology, and the third details motor controls. Technical data, specifications, dimensions, and other options are provided.

Baldor Electric Co., Box 2400, Fort Smith, AR 72902, FAX (501) 648-5792.

For information, circle 700

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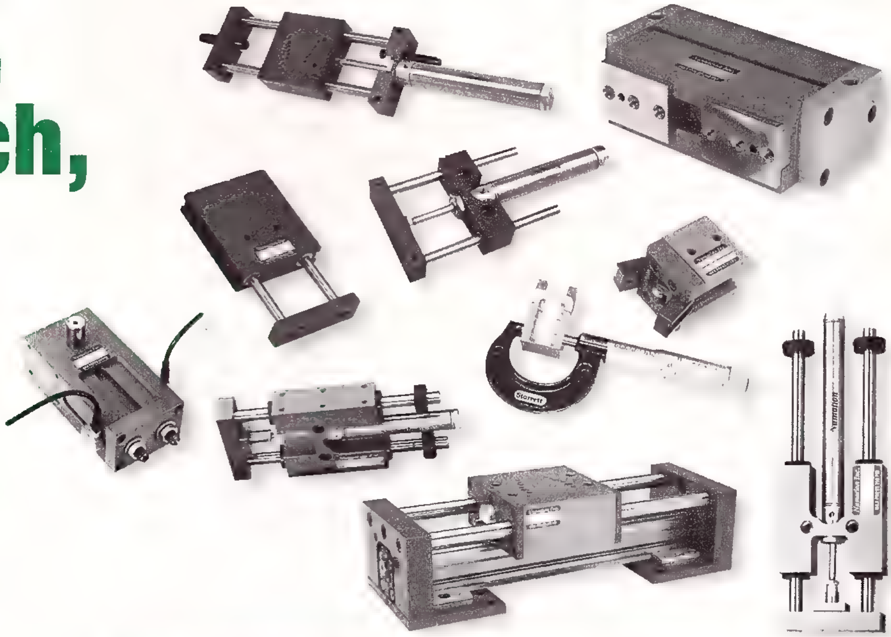
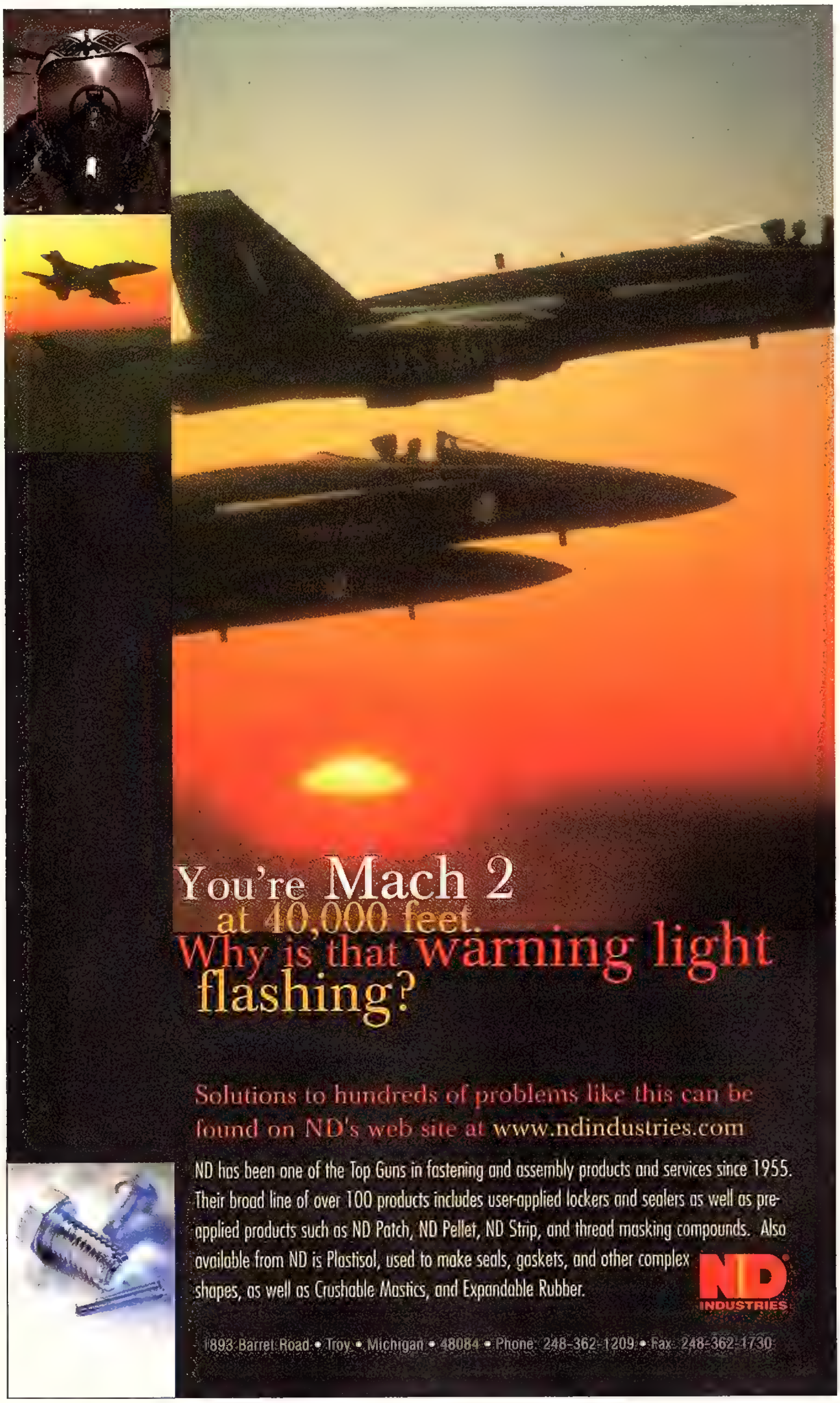


Video measuring system

Micro-Check® computer measurement system contains software, systems, and instrumentation for rotogravure and flexographic printing operations. The system can be used to inspect and measure engraved cylinders or printed cells. Brochure and companion pricing guide provide information on this video measuring system and its features. The pricing guide also includes all products available in the Micro-Check system.

Shima America Corp., 171 Int'l Blvd., Glendale Heights, IL 60139, FAX (630) 871-4152.

For information, circle 701



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Circle No. 276

Potentiometers

XV092 Series low-profile, board-mount rotary potentiometers offer snap-in mounting in both vertical and horizontal configurations. Features include an extended collar for improved wobble characteristics and maximum shaft stability. Data sheet includes product photography, detailed dimensional drawings, shaft configurations, and product specifications.

Noble U.S.A. Inc., 5450 Meadowbrook Industrial Ct., Rolling Meadows, IL 60008, FAX (847) 364-6045.

For information, circle 702

Linear module

MKP linear module integrates the power of a rodless cylinder drive with the travel accuracy of a linear bearing guide. The system features an oval piston design, flexible tension belt, and sealed cylinder chamber. Due to the integral STAR ball rail system, the MKP linear module also affords high travel speeds while maintaining precision and high load capacities. Catalog provides a product diagram, technical data, calculations, and dimension drawings. Mounting information is also provided.

Star Linear Systems, 14001 South Lakes Dr., Charlotte, NC 28273, FAX (704) 583-0523.

For information, circle 703

Medical devices

The Baltic Sea Region brochure presents extensive information on this region and its business opportunities. Other publications from this company include *Health Care*, on the pharmaceutical, biotechnology, and medical device industries; *Information Technology*; *Automotive*; *Direct Marketing*; and *Sweden—Your Northern European Connection.*

Invest in Sweden Agency, 1 Dag Hammarskjold Plaza, 885 2nd Ave., 45th Floor, New York, NY 10017, FAX (212) 702-8780.

For information, circle 704

Automotive body

Automotive Body Int'l magazine for automotive body engineers and managers worldwide explores the latest methods for faster and more-efficient product development with the goal of reducing development time and costs. Upcoming issues will cover advanced body design and engineering, automotive body materials, body manufacturing and assembly, safety and environmental systems, and advanced manufacturing process technologies.

Society of Automotive Engineers Inc., 400 Commonwealth Dr., Warrendale, PA 15096, FAX (724) 776-1615.

For information, circle 705

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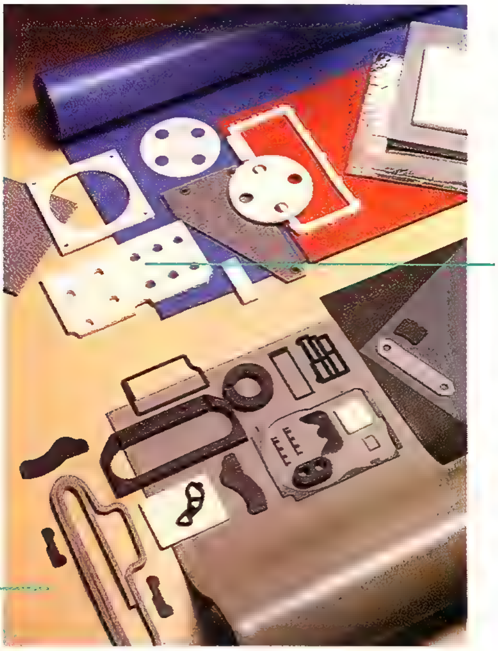

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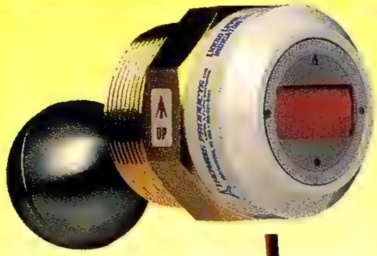

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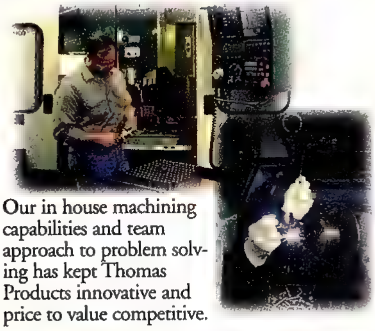

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Switches

Switch Product data book provides specifications, engineering data, and selection guides for the company's switch product lines. These include: general-purpose, miniature, subminiature, and special-purpose basic switches; mechanical keyswitches; DIP switches; lighted and non-lighted pushbutton switches; and thumbwheel switches. The publication also includes general information on mechanical and electrical characteristics of switches, and circuits. A guide details switch problems and remedial actions.

Omron Electronics Inc., 1 East Commerce Dr., Schaumburg, IL 60173, FAX (847) 843-8081.

For information, circle 711

Resins

Brochure describes Capron® Ultra-Tough™ resins which offer low-temperature tolerance for applications in which weldline impact strength at extremely low temperatures is critical. Such applications include automotive components; small-engine and power-tool parts and casings;and cold-weather and high-impact sports gear, such as snowboards, ski components, helmets, and hockey masks. The resins also provide chemical resistance, thermal performance, weldline strength, and surface aesthetics.

AlliedSignal Inc., Box 1087, Morristown, NJ 07962, FAX (201) 455-2000.

For information, circle 712

Shock absorbers

Heavy-duty industrial shock absorbers feature a self-compensating design to provide smooth deceleration under changing conditions. The 2- and 3-inch bore models are targeted for use where velocities or loads may vary within the same application or across a range of equipment. Product catalog provides technical information including deceleration principles, product construction and function, time and force advantages, and self-compensation. A shock-absorber selection is also included.

ACE Controls Inc., 23435 Industrial Park Dr., Farmington, MI 48335, FAX (248) 476-2470.

For information, circle 713

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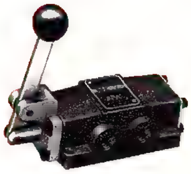

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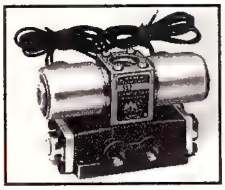

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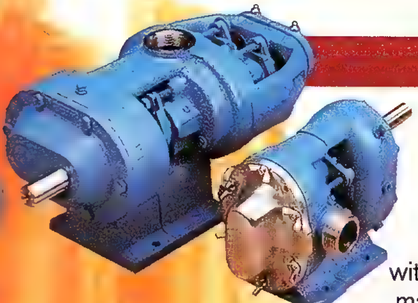
Catalog 103

Circle No. 300

HD SERIES



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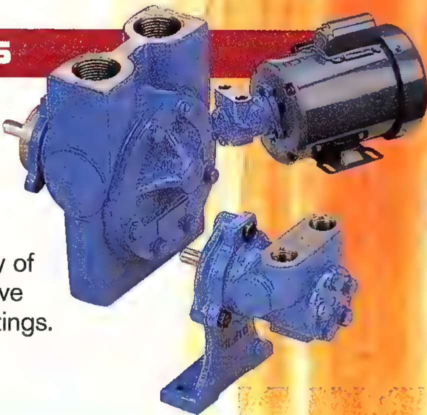

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Catalog 160

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Catalog 165
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Catalog 190

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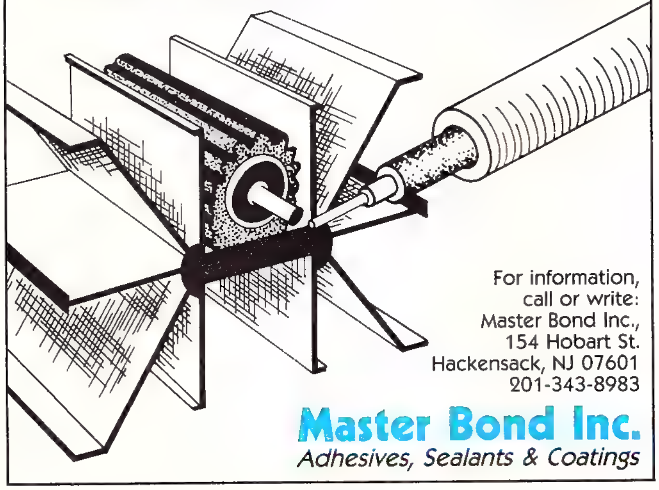

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Circle No. 283

newliterature

Testing database system

Brochure describes the Integrated Testing Database System which allows a user to import data and transducer data from a variety of testing sources, store the data on a single computer platform, identify the specific test information, and simultaneously view the data from multiple images and the results from multiple analyses. The system incorporates a DataBuilder and DataViewer with a Capture and Review System.

NAC Image Technology, 980 Enchanted Way, Suite 203, Simi Valley, CA 93065, FAX (805) 584-3642.

For information, circle **714**

Coaxial connectors

Catalog provides information on coaxial connectors, attenuators, terminations, switches, and fiber optic connectors for use in cellular and wireless communications applications. Product photographs, drawings, and specifications are provided for each product. A part number index is located at the back of the catalog for user reference.

Radiall Inc.,260 Hathaway Dr., Stratford, CT 06497, FAX (203) 375-3808.

For information, circle **715**

Knife assemblies

Model GH-1000 Sur-Cut™ modular guillotine knife assembly cuts products such as film, pouches, and insulation board. The assembly is equipped with couplings to prevent misalignment. Brochure provides information on this and other models; a roll feeder; cut-to-knife, traveling knife, and rotary knife assemblies; a roll-fed inserter; and a 3D dispenser, among others. Product photographs, specifications, and diagrams are included.

AZCO Corp., 385 Falmouth Ave., Elmwood Park, NJ 07407, FAX (201) 791-8420.

For information, circle **716**

Bearings

Design and Material Selection for Dry Rubbing Bearings, Data Item No. 96015, describes the use of computer program A9615 for selecting materials for dry rubbing bearings. The bearings are for applications where a film of lubricating fluid cannot be maintained, such as at high or low rotational speeds. The Data Item describes the preparation of input data for the computer program and illustrates the interpretation of the output through examples. Data on bearing materials based on bulk carbon/graphites and on metals with solid lubricant additions is also included.

ESDU Int'l plc,27 Corsham St., London N1 6UA, FAX +44 0171 490 2701.

For information, circle **717**

Miniature fittings

Miniature pneumatic fittings feature a leak-tight O-ring face seal design to prevent compressed air losses. Seals are available in Teflon, Viton, Silicone, EPDM, AFLAS, and Buna-N O-ring seals to meet temperature and chemical compatibility requirements. M3, M5, and M6 threaded fittings are available, and applications include semiconductor production machinery, medical equipment, factory automation, among others. Catalog describes miniature O-ring face seal fittings, valves, quick disconnects, tubing, pressure regulators, and cylinders. Specifications, diagrams, and information are provided for each product.

beswick engineering Co. Inc., 2384 Ocean Rd., Greenland, NH 03840, FAX (603) 433-3313.

For information, circle **718**

Strain gage technology

Micro-Measurements Interactive Guide to Strain Gage Technology on CD-ROM is produced as HTML documents compatible with PC, Macintosh, and UNIX systems. The guide provides the stress analyst with product and technical information for making strain measurements. In addition to a selection of Measurements Group Tech Notes, Tech Tips, and Instruction Bulletins, the guide also includes Java applets for selecting the proper materials and techniques.

Measurements Group Inc., Box 27777, Raleigh, NC 27611, FAX (919) 365-3945.

For information, circle 719

Coupling lines

Rigid coupling lines now include metric, set-screw stainless steel, aluminum, and english-to-metric conversion couplings. More couplings with keyways, and two-piece couplings are also available. Brochure provides product specifications including torque ratings, keyways, bores, and measurements.

Climax Metal Products Co., 30202 Lakeland Blvd., Wickliffe, OH 44092, FAX (800) 860-5553.

For information, circle 720

Wire products

Pin Catalog No. 103 describes wire products such as straightened and cut wire; non-pointed pins; points, hooks, and teeth; textile pins; and formed pins. Brochure also provides a company background and describes materials, specifications, as well as points and head styles.

W.H. Bagshow Co. Inc., Box 766, Nashua, NH 03061, FAX (603) 882-2651.

For information, circle 721

Gaskets

EMI shielding gaskets feature a core of open-celled polyether polyurethane foam in a high resiliency formula. Profile selection guide describes and illustrates profile options and includes a list of conductive materials and their specifications. A reference guide lists profiles.

Schlegel Inc., 1555 Jefferson Rd., Rochester, NY 14623, FAX (716) 427-9993.

For information, circle 722

Hydraulic pumps/power packs

Model P820 air-driven pumps are used in place of electrically driven power units where electricity is not available or practical, and where the cycle is intermittent and energy would normally be wasted and turned into heat. A double-acting air drive allows for high hydraulic flows and smooth output. Five ratios are available with pressures up to 4,000 psi. Data sheet offers a product description; itemizes key features; and includes a diagram, photograph, and graph that illustrate air pressure. Flow charts illustrate operating pressure.

Hydronic Corp., 32613 Folsom, Farmington Hills, MI 48336, FAX (248) 478-3689.

For information, circle 723

Servomotors

ProMotion servo products include high-performance dc servomotors offering continuous torque ratings from 28 to 640 oz-inches. Both ferrite and neodymium magnet models are available in eight different frame sizes and a variety of stack lengths. Catalog provides product specifications and describes how to select or tailor a motor to suit application requirements. For each product, charts illustrate characteristics. Performance curves, tachometer specifications, and features are provided for each model.

K&D Magmotor Corp., 90 Prescott St., Worcester, MA 01613, FAX (508) 795-1364.

For information, circle 724

Workstation bridge crane

Stand-alone workstation bridge crane brochure highlights features and benefits, considerations for specifying a system, system options, and comprehensive specification/dimensional charts. Brochure discusses general application situations such as where and why stand-alone workstation bridge cranes are useful as an overhead lifting solution. All system options are illustrated, and system components are pictured with explanations of their functions. Charts and diagrams help users to specifiy a system.

Met-Track, Morgantown Business Park, Hemlock Rd., Morgantown, PA 19543, FAX (610) 286-0085.

For information, circle 725

Frequency drive

KBVF adjustable frequency drive provides variable speed control of standard three-phase ac induction motors. Adjustable linear acceleration and deceleration are provided, making the drive useful for soft-start applications. The output voltage is sinewave coded PWM operating at 16 kHz. Data sheet D-800 includes a photograph, product descriptions, and lists standard features. Other features of the datasheet include a chart of electrical ratings, mechanical specifications, and a section on the benefits of the inverters. Connection and motor frequency selection diagrams are provided.

KB Electronics Inc., 12095 NW 39th St., Coral Springs, FL 33065, FAX (954) 346-3377.

For information, circle 726

pH meter kit

Portable pH meter kit is for use with all of the company's handheld portable pH meters. It includes ready-to-use pH 4, 7, and 10 calibration standard buffer solution pouches and rinse-water pouches. Bulletin pH D 2 describes the product's benefits and explains what components the kit includes. Application examples and product specifications are provided, along with photographs.

OAKTON Instruments, Box 5136, Vernon Hills, IL 60061, FAX (847) 247-2984.

For information, circle 727

Workholding mechanisms

Engineering Workholding Mechanisms catalog contains a company process capability and industrial applications overview. Information on workholding mechanisms and their applicationss are also featured. Applications include internal and external diameter collets; diaphragm chucks; clam and finger chucks; expanding mandrels; collet hood chucks; and hyradulic workholding, air, and hydraulic cylinders.

Speedgrip Chuck., Box 596, Elkhart, IN 46515, FAX (219) 294-2465.

For information, circle 728

Pumps

Catalog describes SandPiper diaphragm pumps, most of which are air-driven. Applications for the pumps include chemical handling, of castic, toxic, and corrosive materials; process industries; food and pharmaceutical processing; and automotive. Performance curves, dimensions, and technical data are also included. One section describes the principle of operation, while other sections describe the features of the different pump models through specifications, charts, and diagrams.

Warren Rupp Inc., Box 1568, Mansfield, OH 44901, FAX (419) 522-7867.

For information, circle 729

Hardness testers

Electronic, portable hardness testers feature a two-line LCD display that keeps the user informed of what is happening, shows options, and gives readings. Brochure describes this tester and its functions. Information on the company is also provided, and photographss illustrate available models.

ELECTRO ARC Mfg. Co., 5270 Geddes Rd., Ann Arbor, MI 48105, FAX (734) 483-0206.

For information, circle 730

design news

WEB SITE LOCATOR

Companies listed below offer product information and design assistance on the World Wide Web. Reach them through the home page addresses listed below.

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Pressure Measurement. Web Site details Viatran Corporation's full line of pressure measurement products for a wide variety of markets and applications. Includes complete product information - ranging from capacitance and bonded foil strain gage to silicon piezoresistive and ceramic piezoresistive - application notes, and technical notes. Visitors can search by zip code for location of their nearest Viatran representative.

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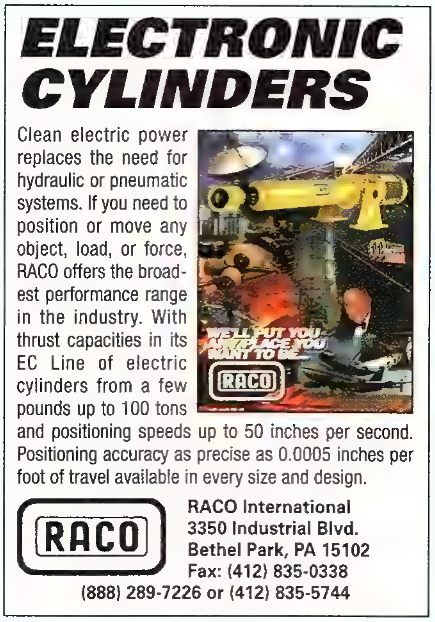

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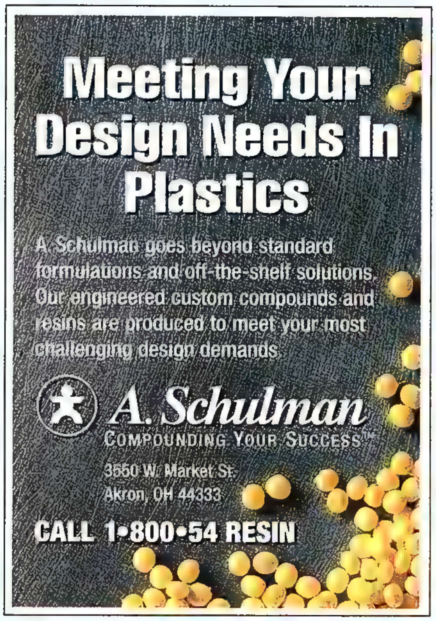

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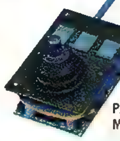

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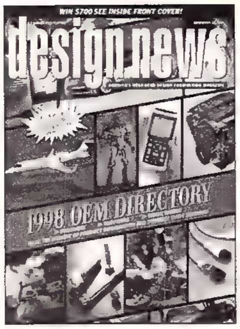

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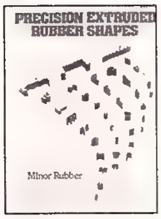

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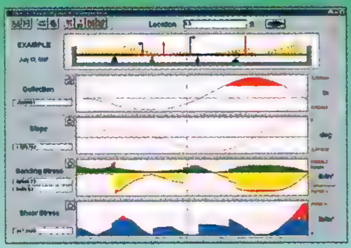

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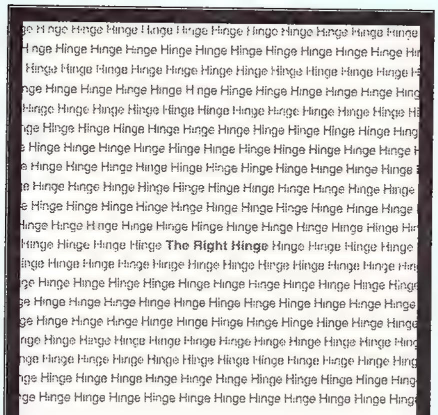

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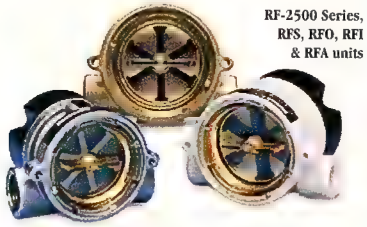

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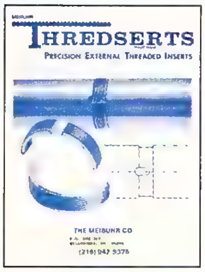

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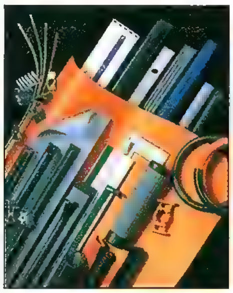

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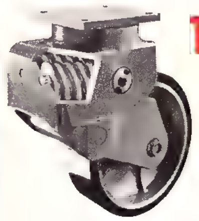

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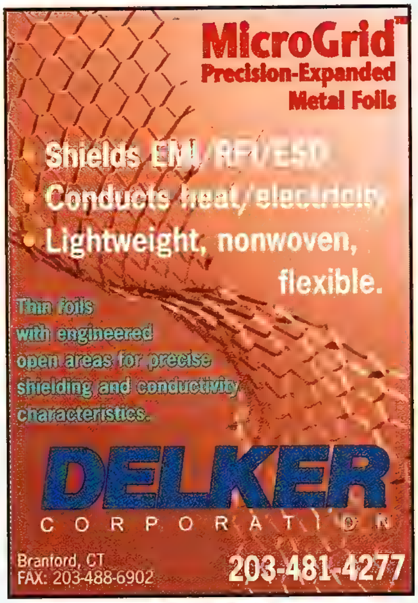

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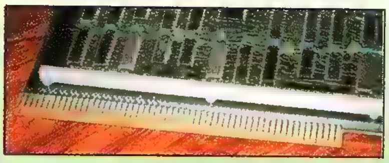

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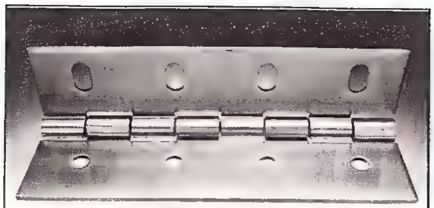

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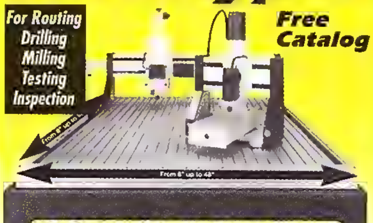

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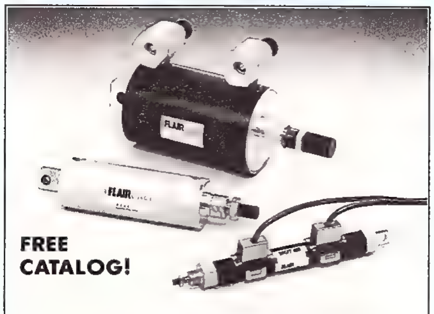

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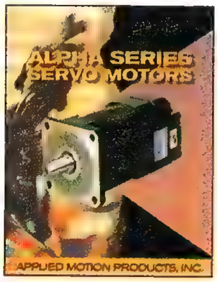

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Thomas C. Curry
President and Chief Executive Officer
The MacNeal-Schwendler Corporation

"Analysis-driven" design, Curry states, is close to a reality at some advanced manufacturers.

Global Design News: ***What advantages can a specialist company like MSC offer customers that seek a single source for their CAD/CAM/CAE and even PDM needs?***

Curry: The answer is in the question: We are "specialists." As much as they may want to be, or even claim to be, the CAD companies can't be everything to everybody. Presently, most of the major CAD vendors are focused on PDM and even ERP because their customers have told them they need better workflow, data management, and integration. They are also providing more CAE as simulation to their design customers who are usually influenced by the engineering analyst. We support this migration of simulation upstream in two ways: We provide tools for the professionals to capture their knowledge and corporate methodology and make it available to their design colleagues, and we "OEM" our technology to companies like UG Solutions and CoCreate for inclusion in their simulation products.

'MCAE is ready to work with digital mock-ups.'

Q: ***How will industry trends like digital mock-ups and simulation-based design affect the implementation of MCAE in the design process?***

A: The use of MCAE in simulation-based design is probably our most exciting area. Our current work centers on a collaborative program, the Robust Design Computation System (RDCS), that uses a parametric version of our MSC/PATRAN modeler, various solvers including MSC/NASTRAN, as well as deterministic, probabilistic, and Taguchi methods for design scans. We have no doubt that analysis-driven design is close to a reality at some advanced manufacturers and we are collaborating with them in this activity. As for digital mock-ups, they create new needs and opportunities for MCAE. Our aerospace experience, where contractors routinely provide large sub-assemblies for combination and execution by the prime, gives us confidence that MCAE technology is ready to work with digital mock-ups.

Q: ***Web-enabled CAD, with applications featuring JAVA as the primary programming language, appears to be just around the corner. What strategies does MSC have for the Internet?***

A: To date, the best uses of the Web we have seen are in the area of data-management and data communication. We are developing a client-server version of our material properties data management capability we call Enterprise MVISION and we have Web-enabled our pre/-post for results viewing. You can expect a stream of Web utilities from us in the year ahead.

Q: ***What does MSC say to engineers who may regard MCAE solutions as appropriate for large projects like the design of automobiles and aircraft, but overkill when applied to smaller products such as medical devices or white goods?***

A: As to the question of MCAE "overkill" for certain products, we don't see that at all. Any manufacturer concerned with time to market can benefit from simulation in place of prototypes and physical testing. We have both white goods and medical products users in our installed base. In fact, I suspect the highest growth rates in MCAE are to be found in new industries coming to the technology for the first time.

Q: ***Many analysis products seem to fall into one of two categories: those that are very basic, or complex analysis tools difficult to understand and implement. What are the functionality limits on the lower-end programs?***

A: We find that the limits on "low-end programs" are not so much a matter of functionality (linear statics, steady-state heat transfer, etc.) as it is the ability of the user to properly synthesize loads and interpret results. However, there is a great deal more work for the CAE industry to do to automate these tasks.

Q: ***What kind of training and support does MSC provide to guide, customize, and otherwise manage the analysis activities of design engineers?***

A: We have organized by industry (aero, auto, and growth) and expanded our scope from standalone software products to comprehensive solutions to better serve the changing needs of our customers. For example, our new multi-media training program for MSC/PATRAN goes far beyond just instructions on how to use MSC/MSC software—it is a tutorial and finite alement analysis theory and application that attacks the very questions that a design engineer has about what possible directions are offered and how to approach engineering problems. In addition, we offer the MSC Institute, on-site training, and hotlines. dn

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Circle No. 289

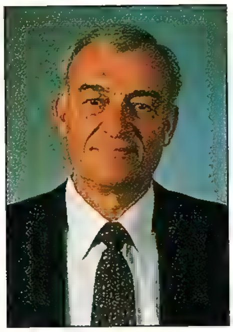
managingdesign

Tips on guiding product development

Develop your intellectual capital

The concept of intellectual capital is rapidly becoming an important asset for most companies, although it often goes unrecognized. Unfortunately, the phrase "intellectual capital" has a vagueness about it that makes it difficult to define or quantify, let alone manage.

Recently, I came across the following simple, yet useful definition: intellectual capital equals the product of competence and commitment.



Ted Gautschi
Consultant
Wellesley Hills, MA

A necessary balance. Neither element is sufficient in or of itself. Competence without commitment is often directed away from an organization's goals. Commitment without competence will frequently produce sub-optimized products. However, when competence and commitment are considered together, they can provide a useful paradigm for dealing with intellectual capital.

Management must recognize that with the increasing emphasis on knowledge work, intellectual capital is rapidly becoming a vital, but often neglected concept. Management should resolve to give it some priority.

The question is, how can management assure that their firms' intellectual capital will continue to grow, and not depreciate over time?

The intellectual capital paradigm requires:

1. **A common vision or strategy** that everyone can support.
2. **An encouraging culture** free from micro-managing, which provides meaningful and challenging work that enables employees to increase their competence.
3. **Open communications.**
4. **Shared gains.**

Develop competencies. Competencies, whether they be technical or management, must first support the business strategy. To do this, most managers use some combination of the following:

1. Replace the less-qualified performers with people who are more qualified. This is not an easy task, especially when the labor market is tight. Also, there is a risk that the new person will not perform as well as the person replaced, since "the grass often looks greener on the other side of the fence." Such action also risks alienating the good performers who were not terminated.
2. Invest in the current workforce to make it stronger by concentrating on activities that will help employees learn new technical and management skills that will increase the organization's intellectual capital.
3. Contract out what cannot be done efficiently or effectively in-house, or use a consultant who has the competence.

'You need both competence and commitment.'

Many firms, especially those in high-tech businesses, tend to focus almost entirely on the competence dimension in an effort to increase their intellectual capital. They tend to ignore tools for the creation and maintenance of commitment. This they relegate to the category of "soft stuff," which they believe has little to contribute to a hard-hitting, fast-moving organization.

However, today's businesses also need committed employees who are involved emotionally as well as intellectually if the business is to continue successfully. dn

**Fax your management questions to *Design News* at (617) 558-4402
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Ask the Manager

Q As I read and learn about improving U.S. competitiveness, two opposing positions seem to pop out. One relates to downsizing or laying off as many people as you can. The other says competitiveness requires a knowledgeable and dedicated workforce. How do you reconcile these seemingly opposing views?

A The answer is to try to do both. That is, try to build a strong, dedicated workforce while at the same time trying to keep costs competitive. The problem is that, until recently, many firms were able to operate on a cost-plus basis without a lot of competition. Now, competition, and improving technology, is forcing companies to design to the price customers are able, and willing, to pay. And, at the same time, they must also be more flexible and produce in shorter time schedules.

Operating in such an environment makes reorganizing and downsizing to produce the same product a must. Large, inflexible, and inefficient organizations can no longer be tolerated. They are going the way of the dinosaur.

At the same time, high employee skills, lifelong learning, teamwork, employee empowerment, and employee involvement are all essential elements for a firm to be competitive. The virtual corporation may be the answer. Such an operation would have a core of owners and managers and technological skills. Then other workers would be hired temporarily, on short-term contracts, or provided by another contractor or vendor. This gives the corporation flexibility in terms of how it does its business, while it provides a range of opportunities to those workers who keep up with their fields and remain productive. Much like the free-agent system in baseball or football, this approach requires a whole new mindset, but it is in our future.

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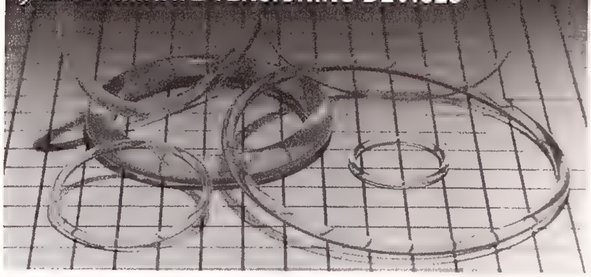

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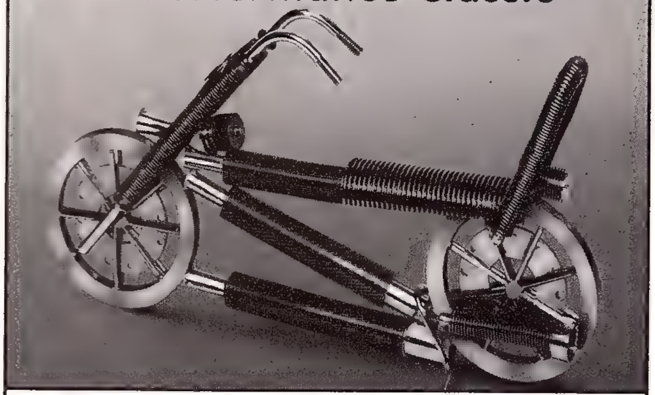

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3D Studio VIZ R2

Hunter Davidson, Jr.
Mechanical Engineer
Northrop Grumman ESSD, Oceanic Systems

3D Studio VIZ is an adaptation of 3D Studio MAX, tailored to enhance productivity in the AEC environment. VIZ and MAX share the same user interface, plug-in architecture, scripting language, and rendering engine. While VIZ lacks some of MAX's advanced animation and post-processing tools necessary for media production, VIZ adds construction and CAD interface tools that greatly improve productivity in an architectural environment. With a significantly lower purchase price than MAX, VIZ also offers designers in other disciplines an economical 3D Studio entry point.

As a MAX user, I was immediately at home in VIZ. The interfaces are identical, with only variations in command availability, so an environment using both VIZ and MAX would be very efficient from a training standpoint.

To test this apparent commonality, I loaded a MAX model I'm currently developing, and simply continued work without missing a beat (I picked a MAX model using only features common with VIZ). As a mechanical designer, I primarily import models created as solids in AutoCAD, and compose, render, and animate in MAX. It's clear that I could perform a significant fraction of this MAX work in VIZ.

VIZ's documentation is clear and well-written, following a task-oriented style that I find very effective. The printed tutorial provides an easy-to-follow introduction, and the Getting Started video tape (a new Studio feature) provides an excellent place for newcomers to begin. On-line documentation is presented through a browser interface, and is as good as any I've seen.

For architectural applications, VIZ offers alternatives such as importing drawings and shapes in a variety of file formats. A typical application might import a 2D AutoCAD floor plan, extrude this plan to create a 3D structure, then add 3D features using VIZ's construction tools. Alternatively, all construction could be performed in VIZ, directly creating the 3D objects.

The real power of VIZ for architectural applications is evident when adding fully parametric features such as doors. They can be extremely time-consuming when starting from scratch; however, VIZ's built-in tools make creation and modification of these objects effortless.

The primary purpose of VIZ is to produce photorealistic rendered images and animations. Using 3D Studio's materials, lights, atmospheric effects, and camera controls, this purpose is well met. VIZ adds the Walkthrough Assistant, a MAXScript application, which automates most standard aspects of walkthrough creation and is a time-saving tool. VIZ also includes a streamlined version of SmoothMove Panoramas, which creates spherical, dynamic, panoramic images that can be interactively panned horizontally and vertically.

More sophisticated VIZ features include drawing linking, which permits associative connection of AutoCAD drawings and VIZ models, and camera match, which lets you place a VIZ model in the setting of a photographic image background, with the VIZ camera matched to the film camera's view and optical characteristics.

Although primarily an AEC tool, VIZ could serve as an excellent Studio entry point for other disciplines. Its capabilities for high-quality rendering and animation can be used for visualization of any design, animated exploded models, mechanism animation, and a wealth of other applications. The primary limitations when compared with MAX are the lack of sub-object animation, video post, and inverse kinematics, with the latter the most significant for mechanism designers.

VIZ is an excellent example of 3D Studio's capacity for enhancement and tailoring for specialized applications. It provides a cost-effective solution for architects, and many others who need realistic presentation of concepts and designs. **dn**

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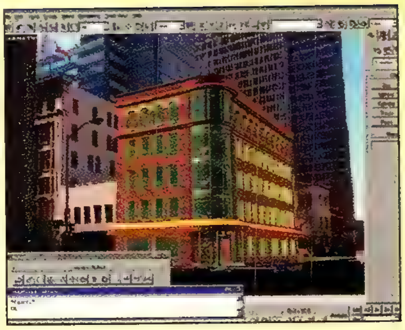

3D Studio VIZ

3D Studio VIZ is a modeling, rendering, and animation application targeting AEC applications. It runs under Windows 95 and NT 4.0. Minimum requirements: 150-MHz Pentium, 64 Mbytes of RAM, and 200 Mbytes swap space, with dual Pentium Pro or Pentium II processors and at least 128 Mbytes of RAM recommended for complex scenes.

List Price: $1,995

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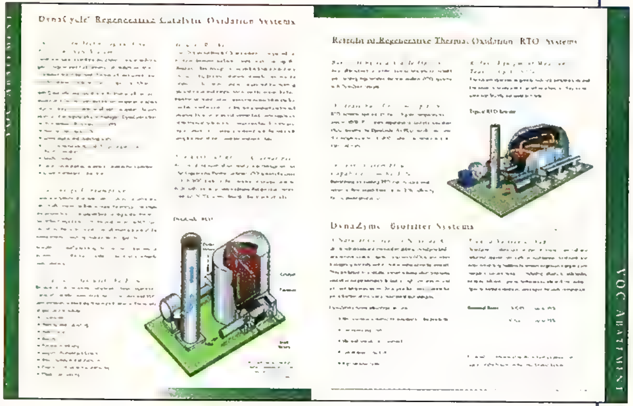
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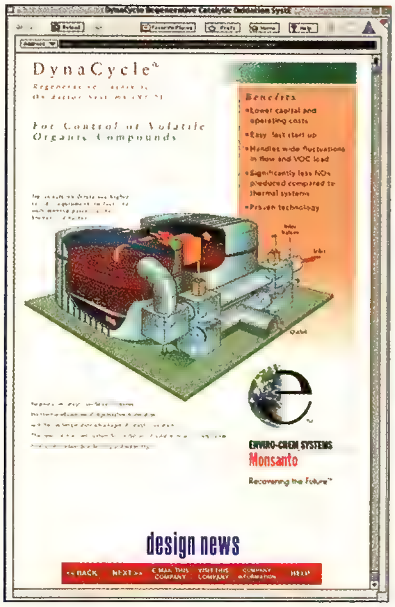

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Laser zaps roadkill hazards

Butte, MT—A Montana Wildlife Bureau laser-equipped truck is being used to reduce the rising incidence of roadkill-induced automobile accidents on the state's highways. The vehicle, equipped with a small industrial laser from Laser Test (Covina, CA), is being used in a pilot program to eliminate small animals in overpopulated habitats near heavily traveled highways. The effort is co-sponsored by WildAmerica, a Montana-based activist group advocating responsible wildlands and wildlife preservation and maintenance.

Overpopulation of several species, such as woodchuck, raccoon, porcupine, and opossum, in recent years has resulted in proportional increases in roadkill tonnage on Montana highways. Because these animals grow rather big in Big Sky country—some weigh in at 15 lb—a run-in with them on the road can damage a vehicle or even cause a driver to lose control. Subsequent vehicles passing the roadkill site often swerve to avoid the remains, generating further accidents. Officials estimate that in the last two years, nearly 1,000 accidents have resulted from initial and secondary roadkill incidents—20 involving fatalities to drivers and passengers, in addition to the animals.

Head Work

A steel-reinforced square concrete column measuring a total of 10 inches on each side is reinforced by 4 bars each having a cross-sectional area of 1 sq. inch. If the ratio of the modulus of elasticity of steel to that of concrete is 10:1, what percentage of an axial load applied to the column is carried by the steel?

A. 4%
B. 9%
C. 29%
D. 91%
E. 100%

—Answer below right

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The truck-mounted laser, pointed out the right side, can eliminate nuisance animals up to 50 ft from the roadway. The laser is computer-controlled and boresighted to aim within the field of view an infrared camera that detects any animal. Data Exclusive (Gardner, MA) image-acquisition shape-recognition software determines if an animal is within the field of view and within effective range of the laser, triggering the beam. Backup is provided by an operator who activates the system when a prospective target is seen as the truck drives along at around 30 mph. Initially a visible-light camera was used, but developers say it gave more false positives, resulting in small brush being set alight. The infrared system homes in on an animal's body heat for virtually 100% effectiveness.

WildAmerica, when approached initially by the commission, was nonplused at the idea. But when shown the accident statistics, as well as the quickness of the device, the group felt it was more humane than the alternative, which could leave animal accident victims thrashing about the pavement for minutes and even hours before succumbing. Lance Piech, head of the group, says, "This system balances our concern for nature as well as our most precious resource, people."

A truck mounted, 0.5-kW infrared laser has been effective in eliminating hazards within 50 ft of Montana highways.

An interesting sidelight to three months of testing this past spring was that operators noticed vultures and buzzards quickly learned to follow the van on its test runs in the Brazos and Butte areas. WildCom officer Curt Freeze says it was apparent that "the fresh killed and cooked carrion is a gourmet treat to these buzzards." The test crew also was able to provide itself with lunches of partridge and quail on several occasions, which tasted somewhat like flavorful barbecued chicken.

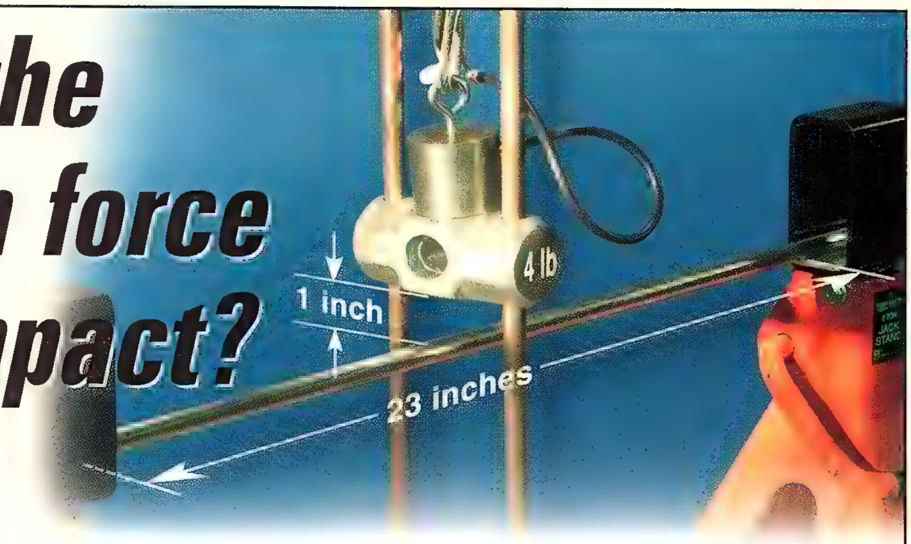
Several other states are considering the roadkill eliminating system. Texas has a particular problem with prairie dog communities of several hundred animals. System tests beginning in August will determine how the laser system functions in such a target-rich environment. dn

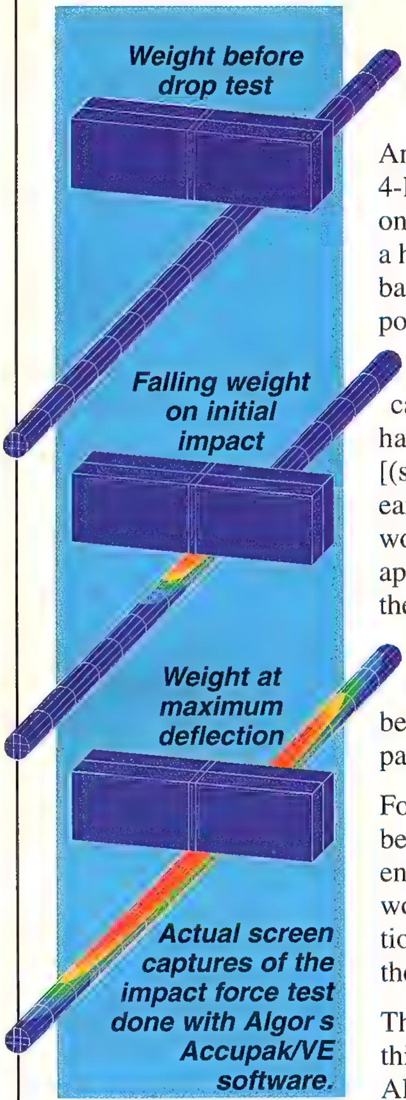
—A Design News crack staff report

ANSWER

C

What is the maximum force during impact?




Weight before drop test
Falling weight on initial impact
Weight at maximum deflection

Actual screen captures of the impact force test done with Algor s Accupak/VE software.

An electromagnet suddenly releases a 4-lb hammer head weight which drops onto a 1/2-inch diameter steel bar from a height of 1 inch as shown above. The bar is 23 inches long between the supports.

In the past engineers would try to calculate the maximum stress using handbook calculations such as [(s=Mc/I); (y=WL3)/(48EI)], or a linear static FEA program but they would have to figure out the force applied to the bar when it is struck by the falling weight.

What would you guess the force generated by the falling weight to be? The answer is at the bottom of this page you may be surprised.

For this simple situation, the force can be approximated by working out an energy balance. This approach will not work, however, for real-world situations due to the difficulty in calculating the stiffness.

The easy way to predict the result of this or any impact problem is to use Algor's Accupak/VE Mechanical Event Simulation software for Virtual Prototyping. Model the bar and hammer head weight with Superdraw III or your CAD system. Apply the dimensions and material properties in Accupak/VE and it will automatically run the virtual experiment and generate a replay showing the stresses and displacements at any or all instants during the time of the event.

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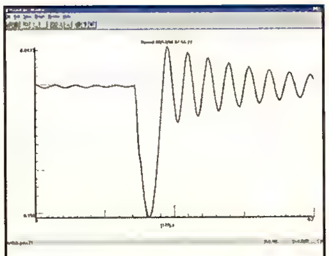

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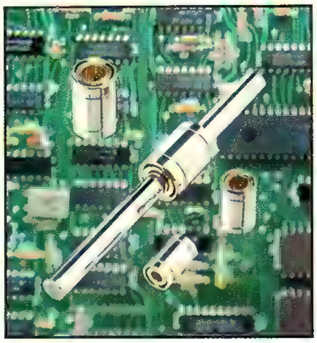

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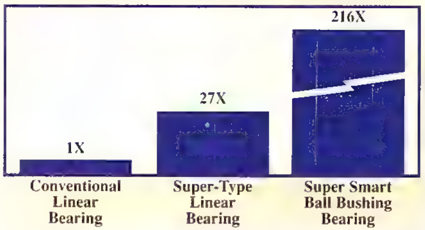

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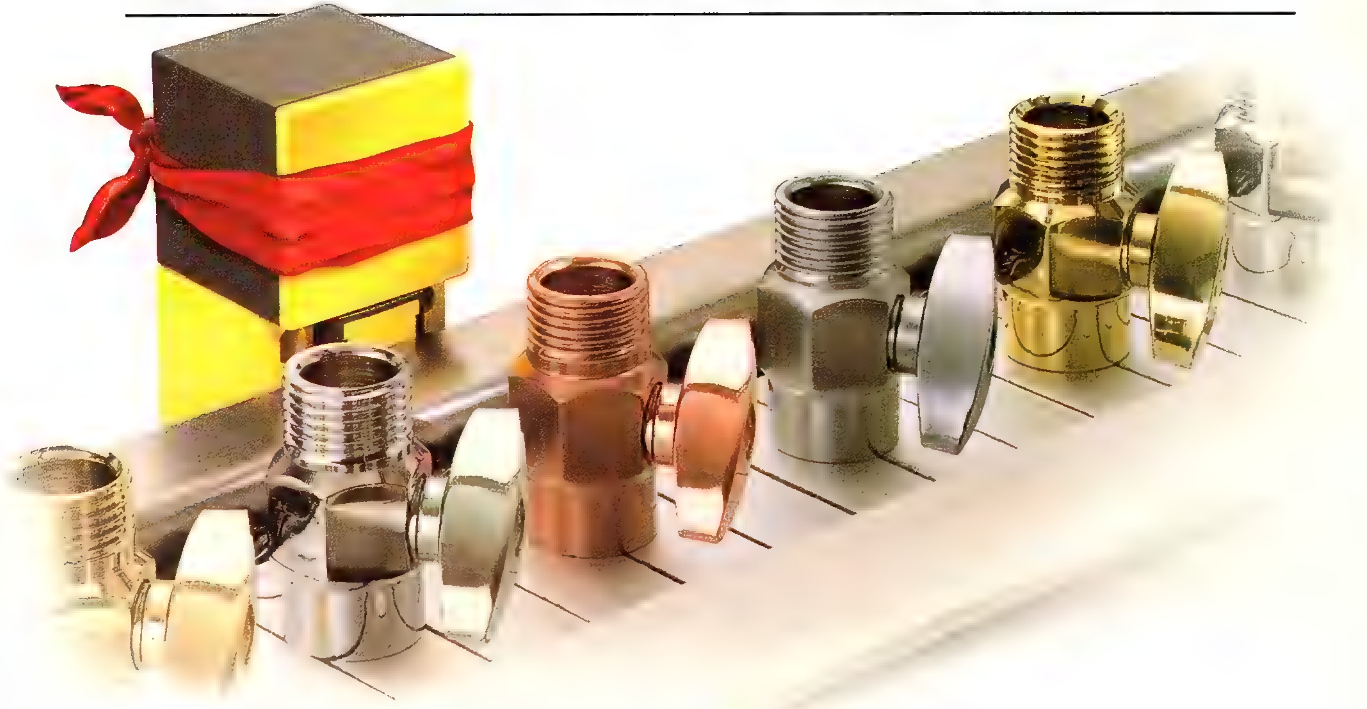

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design news MACHINE TOOLS

MACHINE TOOLS enter a new era

Safety demands, new materials, and standards will spawn machine-tool innovation

Paul E. Teague
Chief Editor

Ever since the first caveman got tired of manually making wheels, people have been looking for new ways to automate production. And their efforts have resulted in the development of some interesting machine tools. They've become a critical part of the manufacturing process—indeed, some would say the most critical part. As we enter a new century, those tools take on added importance as industry tries to cope with ever-increasing demands for speed and safety while accomodating new materials for production. This special supplement of *Design News* looks at the present and future.

First, Senior Editor Charles J. Murray describes the latest efforts to make machine tools safer—efforts that have taken on added importance in the face of tough international standards.

Next up, Technical Editor John Lewis writes about the advantages of laser welding in the automotive industry.

Associate Editor Laurie Peach describes the new look in machine tools, including some of the products to be displayed at the International Machine Tool Show.

For advanced composites to truly reach their potential as design materials, new machine tools will be required. Lewis describes machine tools enabling the use of advanced composites in the aerospace industry.

Simulating machine tool operation before committing resources can save time and money in manufacturing planning, and Senior Editor Murray tells how.

Finally, you'll read the thoughts of one major player on what the future holds for machine tools.

We hope you find this special supplement interesting. Let us know.

Paul E Teague

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Inside

- **Machine tool makers aim for safety . . . . . . S•3**

Machine guarding takes center stage as manufacturers follow the edicts of the European Union, which is calling for tough safety standards

By Charles J. Murray, Senior Editor, *Design News*

- **Laser welding is key to efficiency in auto plants . . . . . . S•13**

Design approach lets engineers reverse part-flow direction, with minimum delay and cost

By John Lewis, Technical Editor, *Design News*

- **The new look in machine tools. . . . . S•23**

Simplicity is the name of the game

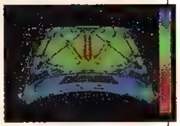
By Laurie Peach, Associate Editor, *Design News*

- **Automated carbon-fiber placement reaches new heights . . . . S•33**

New machines enable use of advanced composites in aircraft design

By John Lewis, Technical Editor, *Design News*

- **Simulation helps create manufacturing processes . . . . S•45**



More than ever before, design engineers must work concurrently with manufacturing teams. Simulation offers a more efficient way to make that happen

By Charles J. Murray, Senior Editor, *Design News*

- **Products . . . . S•53**

- **Advertiser Index . . . S•62**

- **Q&A: Recapturing the competitive edge . . . S•64**

A discussion with Richard A. Curless, Director of Technology Development at Cincinnati Milacron's Machine Tool Group

Cover Illustration: Chuck Mackey

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Line Card, Manufacturers Index, Locations, Service Information	1
Batteries, Circuit Breakers, Fuses, Accessories	2
Cabinets and Enclosures, Fans and Motors	3
Relays, Controls, I/O Modules, Timers, Counters and Sensors	4
Switches	5
Hardware and Tools	6
Cable, Wire, Shrink Tubing, Accessories	7
Connectors, Sockets, Terminal Blocks, Plugs	8
LEDs, Indicators, LCDs, Optoelectronics, Lampholders, Photodiodes, Exit/Emergency	9
Capacitors, Chokes, Inductors, Filters, Crystals and Oscillators	10
Potentiometers, Resistors, Dials and Thermistors	11
Power Protection, Power Supplies, Converters, Electrical Cords, Outlets, Inlets	12
Semiconductors, Heat Sinks, Prototyping Boards, Erasers, Programmers and Static Control	13
Solder, Solder Equipment, Chemicals and Cleaners	14
Telephone, Audio, Security, and Computer Products	15
Test Equipment, Accessories, Panel Meters	16
Transformers	17
Product Index	18

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Circle 803

Machine tool makers aim *for* safety

Machine guarding takes center stage as manufacturers follow the edicts of the European Union, which is calling for tough safety standards

Charles J. Murray, Senior Editor, *Design News*

Manufacturers of machining centers, such as Lamb Technicon's Jaguar, promote operator safety through the use of specialized technology.

It may be the ultimate industrial nightmare: An untrained worker wanders into a production area, catches a loose sleeve on a piece of moving machinery, is pulled in and crushed.

Despite the best efforts of machinery designers and manufacturers, such accidents happen. Loss of life and limb, although comparatively rare these days, still occurs. So do less traumatic machinery-related injuries, such as cuts, scratches, bruises, and strains.

For manufacturers, accidents are costly—not only in terms of human injury, but in lost productivity, fines, and lawsuits. In 1996, work injury costs totaled $121 billion in the United States alone, according to figures released by the National Safety Council. Of this $121 billion, the largest portion—$60.2 billion—represents wage and productivity losses. Days lost because of work injuries totaled 125 million during 1996.

Figures such as those are why standards committees are rethinking their approach to machine safety. They are also the reason manufacturers look for ways to promote safety without damaging productivity. And such figures are why original equipment manufacturers are looking more and more to machine tool makers to incorporate safety systems into their machines—before they arrive at the factory.

The drive toward safety even holds true in automated cells, which make liberal use of enclosed systems, such as machining centers. There, manufacturers must still employ door interlocks, safety circuits, and, sometimes, optical sensors.

"The trend toward machine safety is very strong right now," notes Kimber Lynn Drake, product manager for limit and safety switches at Allen-Bradley (Chelmsford, MA). Much of the impetus comes from the Machinery Directive, a standard drawn up by the European Union with the intention of promoting safety, Drake says. "If you want to ship your machine over to Europe, you have to meet the Machinery Directive standard anyway, so a lot of manufacturers in the U.S. have adopted it as their own internal standard," she says.

TECHNOLOGY SOLUTIONS

That's not to say that there are a hard-and-fast set of widely shared safety standards for today's industry to follow. On the contrary, many of the standards are so ambiguous that it's hard to find unanimity among manufacturers. "When it comes to deciding on what constitutes safe operation, there's a difference in philosophy from plant to plant, from customer to customer, and from continent to continent," says Bryan Graham, director of proposal/simultaneous engineering for Lamb Technicon (Warren, MI), a machine tool builder and systems provider. "All manufacturing plants have different acceptable norms. A lot of that comes from their own experience with close calls and injuries. Good or bad, many of those decisions are based on past experiences."

Based on those experiences, makers of automated machinery have settled on

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For machining clusters, Banner Engineering's Micro-Screen light curtain offers DeviceNet compatibility.

a wide array of safety devices from three basic categories: electromechanical switches, electronic sensors, and mechanical guards.

Electromechanical switches. Machining centers, and most other closed systems, typically incorporate doors or hard guards to separate operators from their work. That's important in almost all cases, because today's high spindle speeds can send metal particles flying. What's more, many machines employ high-pressure coolant sprays, which can also harm operators.

To deal with that, designers incorporate key-operated interlock switches on sliding machining-center doors. Key interlock switches are designed to cut off spindle power when an operator opens the door. They typically have a key that fits in a safety switch attached to the door mechanism. When the door opens, the switch ejects the key, which opens a set of contacts in the safety switch. The safety switch then sends a signal to a safety relay, which opens, thus killing power to the machine.

The key-operated interlock is a long-time member of the safety arsenal, but one that retains its relevancy, especially in light of the standards changes. Made by such companies as Allen-Bradley and Honeywell's Micro Switch Div. (Freeport, IL), key-operated safety switches have been a staple of industry for more than a decade. But they have recently grown in popularity because they can't be easily defeated. In the past, maintenance workers found ways to defeat simpler switches and therefore keep a machine running while they serviced it. Unfortunately, such ingenuity could be highly dangerous. "People have tried to jam screwdrivers into the switches in an effort to keep the machine running," Drake says. "That's why the keys have picked up some pretty elaborate shapes. With these switches, you can't just stick a screwdriver in there and trick it."

Equally important among the electro-mechanical switches is the solenoid key-operated switch, which enables manufacturers to maintain productivity while promoting safety. The solenoid version accomplishes this by *preventing* operators from opening the door while the machine is running. When a machining cycle is completed, and the machine reaches a so-called "zero energy state," the control system energizes the solenoid, which then allows the door to be opened.

The solenoid-style switch is important for two reasons. First, it prevents operators from reaching in until motion has been completely stopped. Merely cutting off power isn't enough, however. If inertia keeps the spindle spinning, the solenoid switch won't let the operator in. Second, it prevents

Subaru-Isuzu Automotive employs Micro Switch light curtains in its Lafayette, IN, assembly plant.

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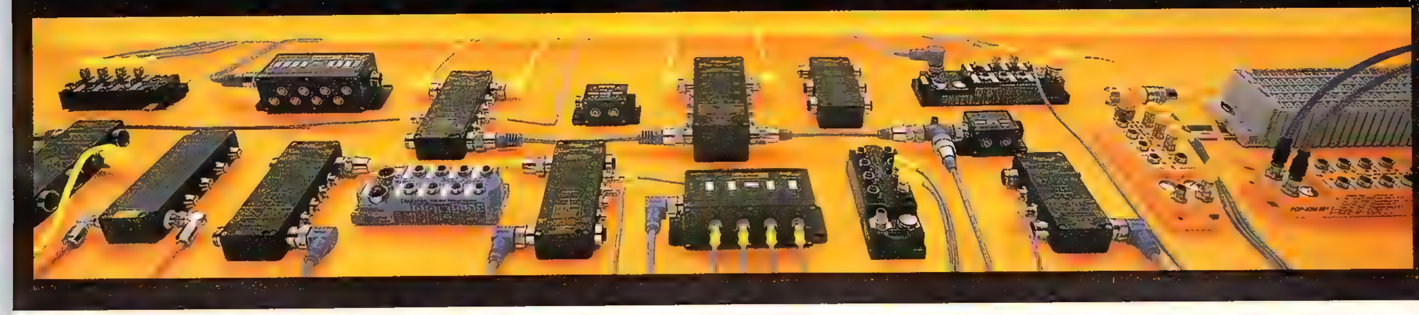


VENDOR-SUPPLIED COMPANY PROFILE

Sensors solve space problems

TURCK's "Q-Pak" proximity sensors fit in confined sensing areas where standard proximity sensors are too large to incorporate. To accommodate different machines and applications, the sensors are available in eight different families with numerous models.

Q-Pak sensors are available with TURCK's patented Uprox technology that senses all metals at the same range, including mild steel, stainless steel, aluminum, brass, and copper. Uprox sensors can save hours of downtime when the target material changes, and users can eliminate time-consuming sensor-range adjustments or the need to specify and replace the original sensor with a longer range version. The sensors also eliminate additional electrical connections.

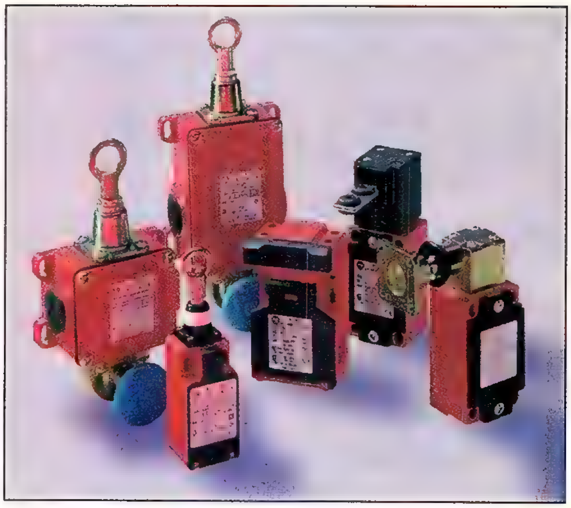
The sensors have no ferrite core and feature three coils rather than the one coil of conventional proximity sensors. This provides longer ranges, weld-field immunity, and an increased temperature operating range.

According to the company, these new sensors provide superior range characteristics versus most standard sensors and still fit in packages up to ten times narrower. For example, an 8-mm-deep Q08 model Q-Pak sensor has 40% more range than a much longer 18-mm-diameter barrel sensor. Furthermore, Q-Pak proximity sensors are fully embeddable in steel. This allows users to mount the sensors further away from the items they need to detect, minimizing damage and replacement costs. Q-Pak sensors are also suited for use in harsh sensing environments.

Because Q-Pak sensors with Uprox technology eliminate the ferrite core of conventional proximity sensors, they are inherently weld-field immune. Therefore, they are unaffected by strong electromagnetic ac or dc fields, such as resistance-welding operations. As a result users can eliminate false triggering of sensors and assure reliable sensor operation in severe ac or dc weld fields.

Uprox sensors are also not limited by temperature extremes, having an operating temperature range from -30 to 85C. Some TURCK Q-Pak sensors can be mounted from the front to utilize their narrow depth, other models can be mounted from the side to minimize the width of the sensor. **Circle 800**

damage to valuable parts and tooling. The reason: If the door suddenly flies open during a machining cycle, the machine could apply a brake to stop motion, thus damaging the tool head. It could also ruin valuable parts, such as engine blocks or valve manifolds, which are being machined. By waiting until the machine reaches a zero-motion state, however, the solenoid key-operated switch maintains productivity. “Every machining center uses some kind of interlock guarding device to lock the doors during the machining cycle,” notes Jeff Otterstein, business development lead for machine safety at Honeywell's Micro Switch Div.. “It's the best way to keep from damaging the work piece or the tool itself.”

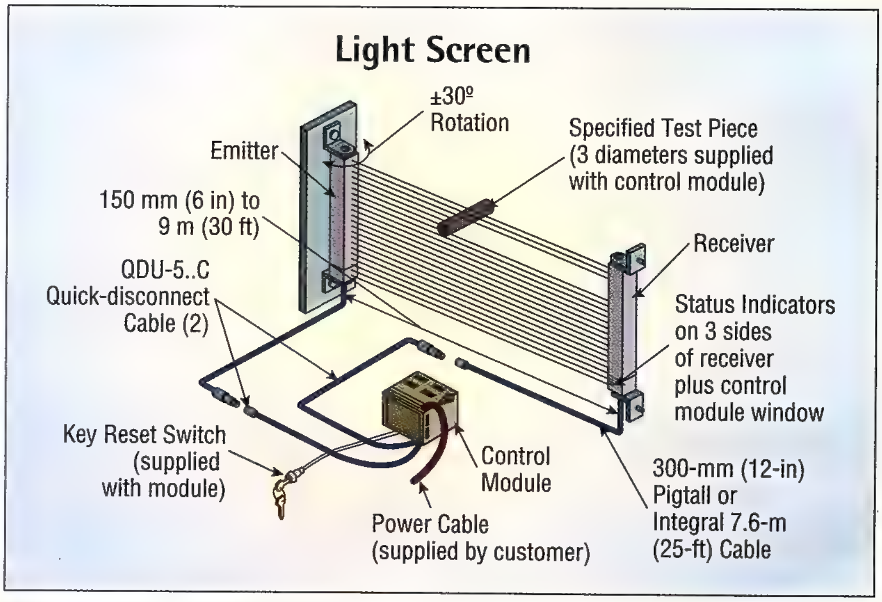


Allen-Bradley offers a variety of key-interlock and cable-pull safety switches, including solenoid-type, which ensure that guard doors cannot be opened until a zero-motion state exists.

The electromechanical switch category also incorporates other types of safety switches, including hinge switches and magnetic switches. Hinge switches typically operate in a fashion similar to that of the key interlocks. Instead of keys, however, they usually employ a lever that attaches to the door. When the door opens, the lever actuates the contacts. Similarly, the magnetic version uses magnets and Reed switches. Users attach one to the machine cabinet and the other to the door. When the door opens, it separates the two, thus opening the contacts.

Whatever type of interlock is employed, users can add redundancy to the safety system by incorporating relays that fail safe. Hengstler Kaco Relays (Chicago, IL), for example, uses a force-guided design intended to ensure that all contacts will not be simultaneously closed. As a result, contact welding does not prevent the safety system from cutting off power.

Electronic sensors. In recent years,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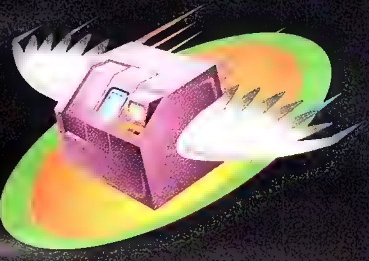

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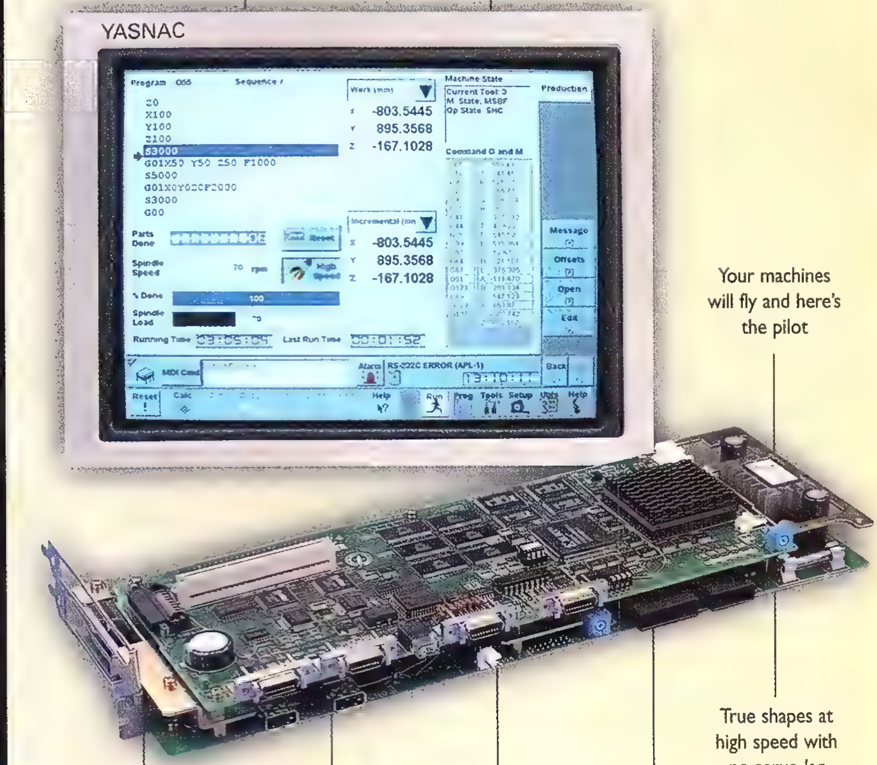

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electronic sensors have gained favor among users because of advancements in technology and the ability to customize it to specific needs.

The most prominent of those is the light curtain. Manufacturers around the world employ them as guarding devices in factories, typically near hazardous zones. The type of light curtain used depends on several variables, including the size of the zone, the potential severity of injury, and the duration of exposure—that is, whether or not an operator keeps his or her hands in danger for long periods of time.

Most light curtains use photoelectric elements, or light-emitting diodes (LEDs), and receivers to form a plane of light. When a person breaks the plane, the receivers fail to gather light. The system then sends a signal to a safety relay, which opens or closes (as appropriate for the particular relay), and shuts down power to the machine. "The light curtain gives you the ability to safeguard your machine in a control-reliable sense," says Richard Mills, Safety Controls Div. manager for Sick Optic Electronic (Bloomington, MN). "And at the same time, you have full access and visibility in your work space." Suppliers such as Sick Optic and Honeywell's Micro Switch Division produce light curtains with varying numbers and densities of photoelectric beams to suit the severity of the application.

More recently, one firm has produced a light curtain model that is compatible with the DeviceNet fieldbus network. Known as the Micro-Screen and made by Banner Engineering (Minneapolis, MN) the new unit enables users to more easily monitor status of light curtains and troubleshoot them.

In a limited number of applications, light curtains have even been used as an alternative to hard guards, such as sliding doors, on machining centers. "When the operators put their hands through the invisible beam of light, it sends a stop signal, just as the interlock would, notes Victor Caneff, marketing manager for safety products at Banner Engineering. Typically, Caneff says, customers use light curtains instead of, or along with, sliding doors, particularly when there is a possibility of the door trapping someone's hand.

Suppliers have also recently developed the ability to scan "configured" areas, rather than just simple rectan-

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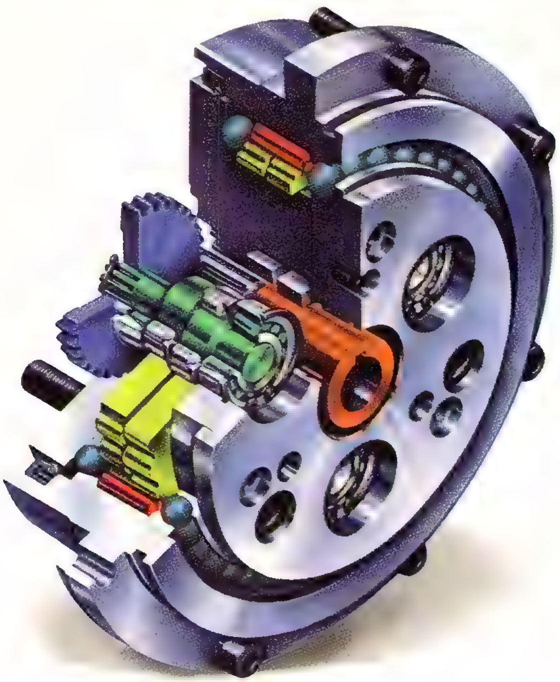

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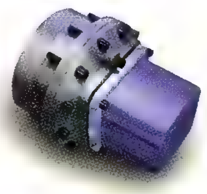

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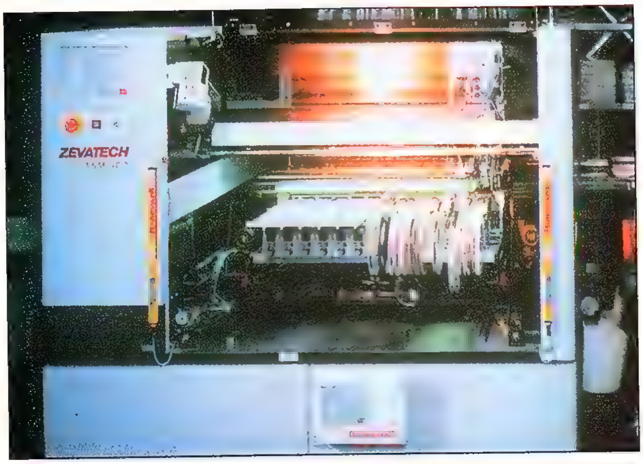
gles, using devices known as proximity scanners or laser scanners. "We've done trapezoids, semi-circles, and other irregular shapes," notes Mills of Sick Optic, which offers a proximity scanner. "We've even done an outline of the state of Minnesota." Honeywell's Micro Switch Div. also offers a safety laser scanner, which uses laser and radar principles to scan computer-defined areas around dangerous machinery.

Makers of machining centers are also finding new applications for light screens by applying the concept of muting, or bypassing. In muting, a special module overrides the signals from the light curtain that would ordinarily shut down a machine. Micro Switch's muting module, for example, is controlled by two or four photoelectric sensors, which identify events around the work area. When the module finds favorable conditions, it initiates the muting sequence, thus allowing the safety system to ignore the signal from the light curtain. Such modules are primarily used as a means of allowing parts to enter and exit work areas more easily.



Mini-curtains from Honeywell Micro Switch cut off machine power when an operator breaks the light curtain.

Mechanical guards. Despite the proliferation of high-tech safety products, users say that mechanical guards—doors, sheet metal walls, and fences—are still among their most important aids. "The first thing we look at, in any system, is a stationary, non-functional barrier," says Graham of Lamb Technicon. "A simple barrier can prevent people from coming in contact with a machine that might be harmful to them. It could be solid metal, or plexiglass, or a ribbed surface that you can see through. Whatever kind we use, stationary barriers remain as one of our most effective machine guards."

Graham says that Lamb Technicon often builds its own barriers, or in some cases buys them from sheet metal suppliers. The advantages of such systems, he says, is that they contain noise, flying metal chips, and coolant sprays. And

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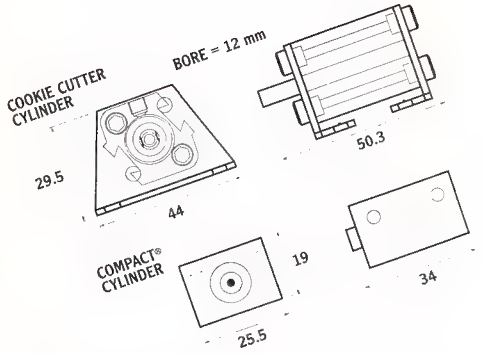

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they accomplish that in the simplest and most effective ways possible, he says.

DESIGNER'S RESPONSIBILITY

Despite all the concerns over the new Machinery Directive, the European Union isn't the only committee to tighten safety regulations. U.S.-based standards committees are said to be looking at other safety-related issues, as well.

The issue of "stored energy," for example, has stirred debate among machine makers and original equipment manufacturers. Stored-energy regulations would forbid the use of any energy storage while a machine is in its unpowered state. As such, no items could be held aloft by brakes, and hydraulic systems would not use accumulators. In some cases, capacitors might also be forbidden. If that issue finds its way into the standards, it could

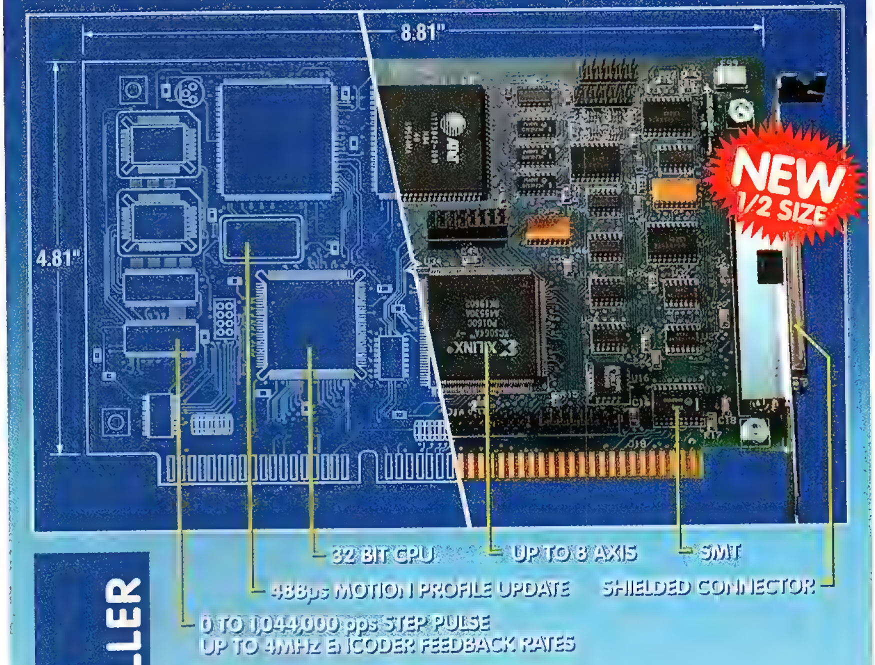
Understanding the Machinery Directive

Since arriving on the scene in January 1997, the European Union's Machinery Directive for safety components has changed the way designers think about safety. Now, machine builders need to display a "CE" mark to signify compliance with the directive. If they don't, they can't sell their machines in Europe.

Despite those dire consequences, many manufacturers aren't sure how to interpret the standard. "There is some ambiguity when it comes to safety standards," says Bryan Graham, director of proposal/simultaneous engineering for Lamb Technicon (Warren, MI). "And that ambiguity can lead to shock among customers when they get competing quotes for new manufacturing systems. Sometimes, those quotes can vary widely."

To help users interpret the standards, Rockwell Automation (Chelmsford, MA) has produced a 148-page book, *Understanding the Machinery Directive.* Other manufacturers, including Sick Optic Electronic (Bloomington, MN), have produced similar volumes designed to help engineers and quality assurance managers better understand CE marking.

To help interpret new standards, Rockwell Automation offers a 148-page book titled "Understanding the Machinery Directive."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Circle 810

again send machine designers scrambling for more new technology.

Surprisingly, however, machine designers find that the safety decision may not always be theirs anyway. Ultimately, a high percentage of the decisions are made by the manufacturer, they say. "We usually get a specifications book from the company that we design the machine for," notes Larry Kramer, a controls designer for Balance Engineering, a Michigan-based machine manufacturer and systems provider. "Very often, the customer has a specified parts list that tells us what to use. If we want to deviate from that, we have to submit a standard deviation form."

Still, safety is a topic that begs for the attention of machine designers everywhere. Experts say that machine designers must know how to interpret the likelihood of hazards, and understand how those hazards affect load time, unload time, cycle time, and the production rate of their machine. No matter who determines the specifications, it's the designer who takes the responsibility for making the solution work during a potential emergency. Says Graham: "Ultimately, machine designers must feel confident that if an operator is in harm's way, their machine will not operate."

Micro Switch's laser scanner uses laser and radar principles to scan computer-defined areas near hazards.

For more information

Safety switches from Allen-Bradley	Circle 750
Machining centers from Lamb Technicon	Circle 751
Safety switches from Honeywell's Micro Switch Div.	Circle 752
Relays from Hengstler Kaco Relays	Circle 753
Light curtains from Sick Optic Electronics	Circle 754
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Circle 850

Laser welders are key to efficiency in auto plant

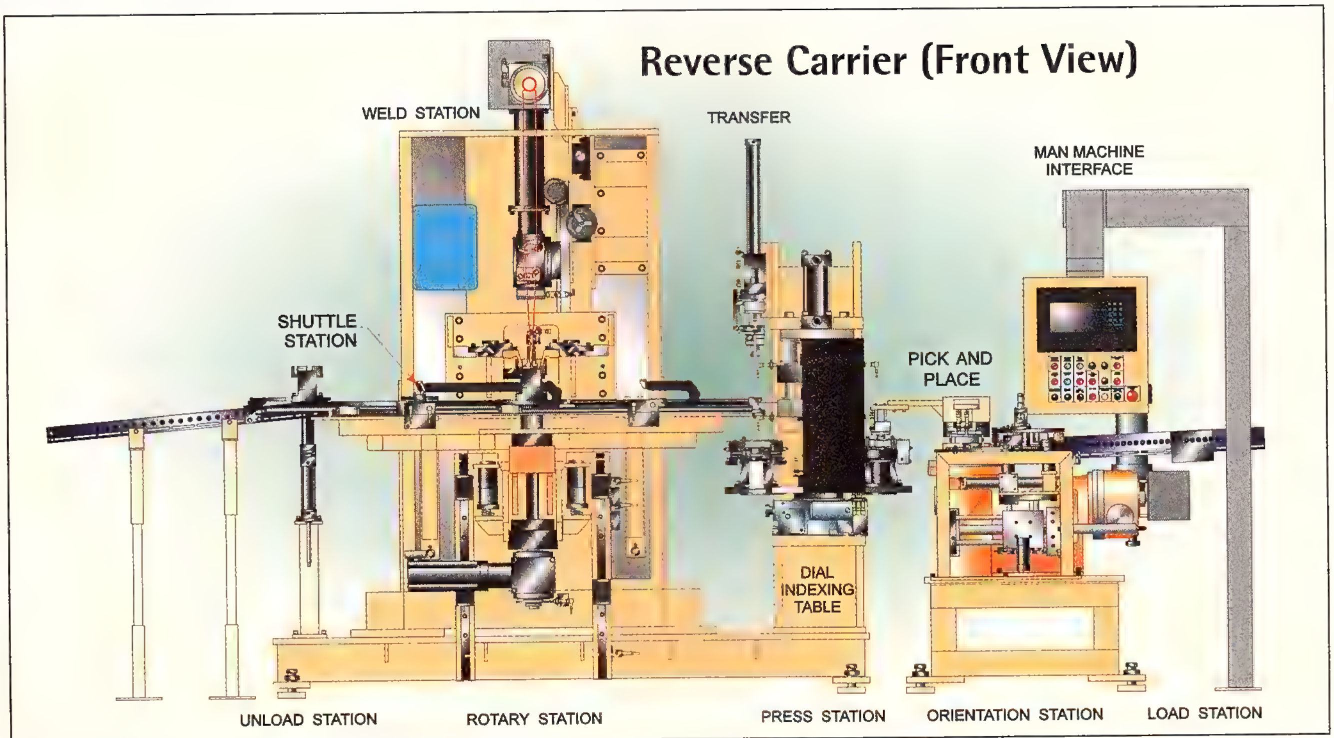
Design approach lets engineers reverse part-flow direction, with minimum delay and cost

John Lewis, Technical Editor, *Design News*

Chrysler's Indiana Transmission Plant (ITP), near Kokomo, is the nation's newest and one of the world's most technologically advanced. Automatic laser-welding systems, built by Detroit-based DCT Utilase Systems Inc., produce several key subassemblies of the 45RFE four-speed automatic overdrive transmission that will propel Chrysler's new rear-wheel drive Dodge pick-up trucks and Jeep Sport Utility vehicles.

To reduce weight and cost, Chrysler's transmission designers use precision stampings in place of machined castings. Thinner sections and higher residual stresses typical of stampings require very precise heat control to avoid excessive distortion during the welding process. Laser welding was the obvious choice for ITP because it is inherently precise and controllable, and makes it possible to accurately regulate the heat applied to a part.

Using a standardized approach, DCT engineers developed a basic laser welding machine that accommodates all parts



DCT Utilase Systems' automatic laser-welding machines produce transmission sub-assemblies at Chrysler's new Indiana Transmission Plant. Using a standardized approach, DCT engineers developed a basic laser welding machine that accommodates various parts with greater than 50% commonality in major structural components and key subsystems.

VENDOR-SUPPLIED COMPANY PROFILE

Controllers solve complex problems

In 1983, Jacob Tal, former professor in the Electrical Engineering Department at the University of Utah, and Wayne Baron, an engineer at Hewlett-Packard, invested their personal savings and co-founded Galil Motion Control—developers and manufacturers of high-performance motion controllers. After drawing no salaries and reinvesting everything back into the business, Jacob and Wayne grew Galil into a company with more than $25 million in sales, with fifty consecutive quarters of profit. Galil is located in the heart of Silicon Valley (Mountain View, CA) and has more than 25,000 sq ft of manufacturing space.

Because of their technology's simplicity and cost-effectiveness, Tal and Baron knew they had developed motion control products useful in the OEM marketplace. Tal and Baron also realized the need to educate engineers about this new technology. To do so, Galil offered motion control seminars to engineers, not only to instruct them, but to also let them see the possibilities of applying a motion controller in their own design environment. More than 10,000 engineers have attended Dr. Tal's seminars.

Today, more than 200,000 controllers are at work in industries such as machine tooling, manufacturing, medical equipment, aerospace, materials handling, semiconductor manufacturing and testing, food processing, textiles, and in test and measurement equipment.

Galil's motion controllers solve complex motion problems and include linear and circular interpolation, electronic gearing, and electronic CAM. The DMC-1700 Series of ISA bus motion controllers provides up to 8-axes on a single card, and the DMC-1400 Series is for 1-axis applications. Software design tools feature non-volatile memory for storing programs and programmable I/O, and interfaces are available for ISA, CPCI, VME, PC/104, and RS/232. **Circle 812**

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with greater than 50% commonality in major structural components and key subsystems. A common control system further standardized the machines. DCT engineers combined the laser and mechanical controls into an integrated system with a single HMI (Human Machine Interface). To simplify the operator's task, engineers consolidated all system inputs and outputs at a single location, and integrated data exchange with ITP's factory information system.

As it turned out, this standardized approach resulted in design symmetry that was key in keeping the project on track. "Chrysler's requirements changed, quite literally, 180 degrees overnight," says DCT Manager Matt Jurczyszyn. "Initially, all machines were designed to process parts from right to left because the bases and subassemblies were laid out identically. As the plant floorplan developed, however, ITP wanted four laser welders to process parts from left to right."

The base weldments had already been built. And the left-to-right requirement was firm. So DCT engineers re-examined the design and found a "fix." Standardization, in this case, also included symmetry, which meant that part flow through the machine could be "turned around" with a minimum of re-engineering. Most of the subsystems for part handling were also symmetrical, so DCT engineers met the new requirement with a minimum of delay or additional cost, averting a potentially serious delay of machine build and start-up at ITP. The fact that the weldments were fabricated by another DCT division also contributed to the efficiency of the change.

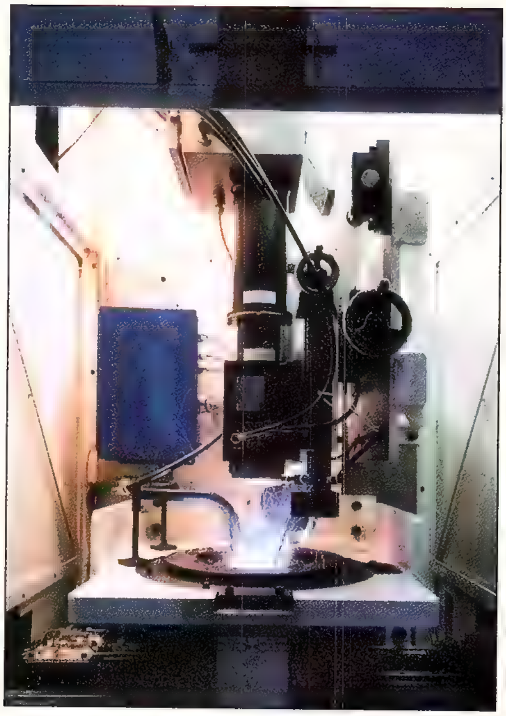
Parts processed on DCT's laser welding equipment at ITP include: reverse carriers, reaction carriers, reverse clutches, overdrive clutches, carrier annulus gear, and reaction annulus. The input carrier annulus is a four-component assembly in which an input shaft and a carrier cup are first welded together. Then a plate and annulus gear are added to complete the unit. The reverse carrier and reaction carrier each require two welds. The balance of the parts have only one welded component.

The reverse carrier welding process is a typical example of the operation of all the DCT welding equipment supplied to ITP. It consists of a load station, a press station, a transfer station, a laser weld station, and an unload station. The part itself is composed of two stampings, a "cup" with four "windows" around its periphery, and a "plate" with tangs that fit into notches in the top edge of the cup.

Both the plate and the cup have four holes arranged in a non-symmetrical pattern which hold pinion shafts in the completed carrier assembly. The pinions protrude through the "windows" in the cup to engage reverse gears in the transmission. Since the hole pattern is non-symmetrical, orientation of the mating parts is the fist order of business in the welding cell.

The cup is delivered open end up by Chrysler-supplied automation. The DCT load station radially orients and rotates the cup until a fiber-optic sensor locates a manufacturing hole. The cup is then lowered into a post-orient nest that maintains orientation until the cup proceeds to the next station.

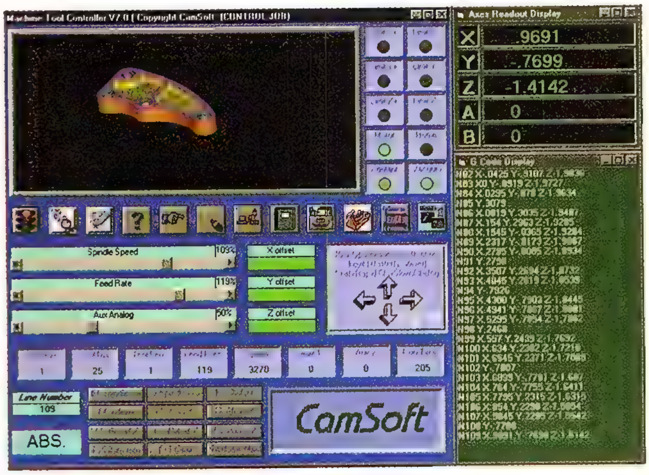
An operator loads the plate from dunnage into a magazine loader with a specially designed tool. The magazine loader has a two-hour unsupervised



To reduce weight and cost, Chrysler's transmission designers use precision stampings in place of machined castings. Thinner sections and higher residual stresses typical of these stampings demand the precision heat control that laser technology offers to avoid excessive distortion during the welding process.

CamSoft and Galil Solve Very High Speed Machine Tool Applications

A revolutionary concept by a company called CamSoft converts screen graphics directly into multi-axis machine tool motion. When joined with a powerful Galil motion controller, the company's software allows very high speed machine tool applications to be solved.

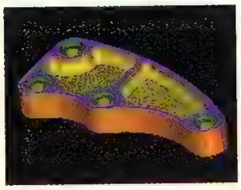


CamSoft's machine tool controller turns a PC with Galil's DMC-1000 installed into a powerful CNC.

High speed is particularly important in applications such as mold making where a large CNC file needs to be processed quickly when prescribing complex 3D profiles in real time. CamSoft's tool kit finds important uses in applications involving such varied machine tools as milling machines, lathes, and water jets.

CamSoft's complete machine tool kit for the PC combines a software package (including a CAD/CAM system) and a high speed Galil motion controller. The tool kit does not require a hardware PLC—all logic is handled through Windows. The CamSoft tool kit can respond to events in real time in a few milliseconds.

CamSoft uses the Galil DMC-1000 motion controller in configurations from two to eight axes. For example, one application for the CamSoft tool kit uses the linear interpolation mode of the DMC-1000 for simultaneous five-axis control where new segments can be sent ahead of motion and the vector speed can be changed on the fly.



The CamSoft engineers particularly like the ease of programming and the flexibility inherent in the Galil motion controllers.

The CamSoft engineers particularly like the ease of programming and the flexibility inherent in the Galil motion controllers.

According to Gary Corey of CamSoft, "There is so much programming flexibility in the Galil controller. I can program it to do whatever I want, and even make it work beyond the capabilities listed in the manual."

CamSoft also likes the technical support offered by Galil. "The Galil engineers promptly answer my questions. This is important because I really am exercising the full potential of the controller," says Corey.

The Galil motion controller incorporates many "extras" as standard features. In particular, CamSoft customers need the digital I/O and analog inputs, both standard features of the DMC-1000.

CamSoft's software provides an easy-to-use graphical user interface and can be customized by the user for a particular CNC application. The user does not have to be a programming expert and is provided with a variety of tools to build the interface such as colors, buttons and sizing for any Windows platform.

The graphics can be drawn in the CAD/CAM system that is included in the tool kit or they can be imported from standard CAD file formats such as DXF, IGES, Gerber or HPGL. There is no program size limitation. And, because the Galil motion controller and the CAD/CAM system are in one integrated unit, no code needs to be written or reviewed. The standard programming method allows for manual or "off line" G Code programming, as well.

CamSoft, located in Lake Elsinore, California, was founded in 1981. So far more than 7,000 software CamSoft systems are at work in the machine tool industry, solving a variety of applications.

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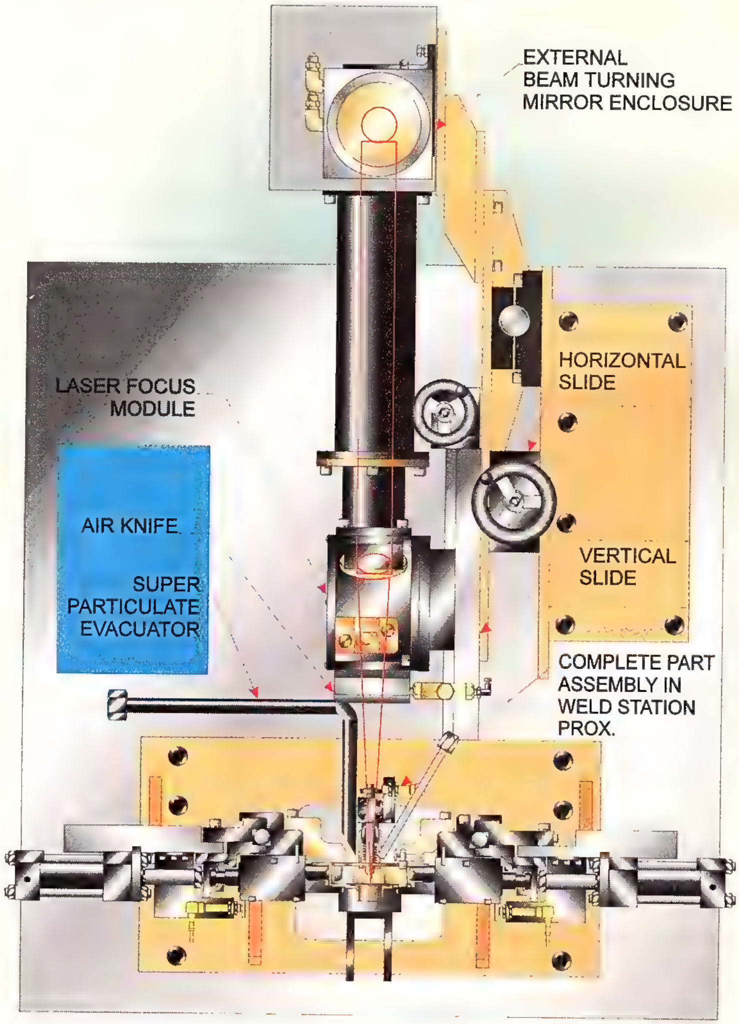
run capacity. A gripper, mounted to a two-position slide, transfers the plate from the top of a magazine to an orienter. This orienter locates the plate to a manufacturing feature that has the ability to flip the plate over should it be delivered upside down. After the cup and plate are properly oriented, they are loaded into the press station by the pick-and-place automation.

The press station uses a four-station indexing table with two press fixtures to assemble parts. The manual load option at the process station maintains production if line automation fails. After the cup and plate are loaded, they are indexed to the press station where the plate is pressed down over the tangs on the top edge of the cup. The assembled part is then indexed to an unload position where it is picked up by a three-position slide and placed into a shuttle transfer that loads the assembly into the welding station.

The shuttle delivers the pressed cup/plate assemblies over a rotary fixture at the weld station. The fixture raises the cup/plate assembly out of the shuttle fixture to a height where four gauge blocks are inserted through the windows of the cup. This tooling provides precise spacing between the plate and the bottom of the cup, and also assures that they are parallel within

Weld Station and Beam Delivery (Front View)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VENDOR-SUPPLIED COMPANY PROFILE

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NTN offers a range of bearing types for its customers. According to the company, It's hundreds of employed engineers are dedicated to problem solving and helping the manufacturer improve the quality and design of manufacturing equipment. The breadth of NTN's product line includes but is not limited to:

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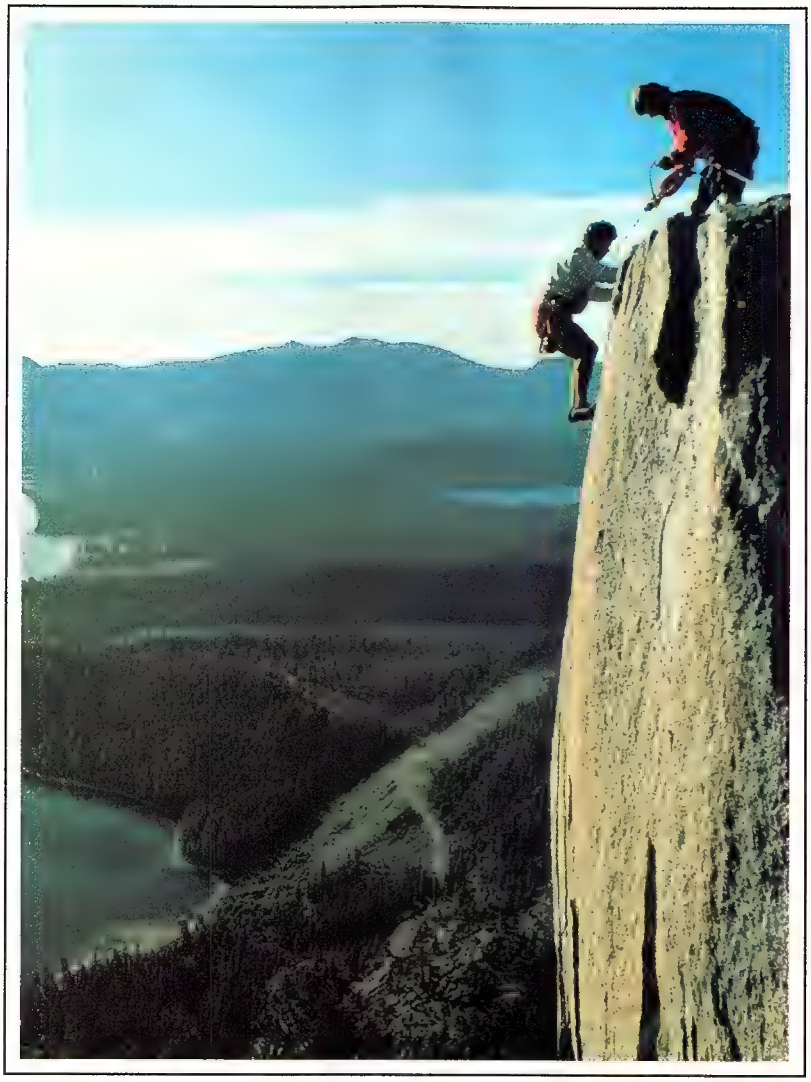

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Circle 813

VENDOR-SUPPLIED COMPANY PROFILE

Gear drives spur growth

For more than 60 years the Stober brand name has been synonymous with gear-drive value. Stober ComTrac™ adjustable-speed traction drivers, MGS™ (Modular Gear System) speed reducers and gearmotors, and ServoFit™ precision planetary gearheads are just a few of the products that contribute to this reasoning.

Decades of application support, advanced gear technology, and a worldwide customer support strategy have positioned Stober Antriebstechnik as a world leader in providing gearing-technology solutions. Stober was founded in 1934 in Pforzheim, Germany, which is located 100 miles south of Frankfurt and is famous for jewelry and watch making. The company was first known for general machine building and motorcycle repair.

In 1943 Stober designed, developed, and manufactured its first mechanical variable-speed drive. The company introduced its worm gearmotor line in 1969 and its helical in-line gearmotors in 1982. During those years Stober began to expand into the areas of dc motors and controls, frequency-regulated drives, and servomotor drives.

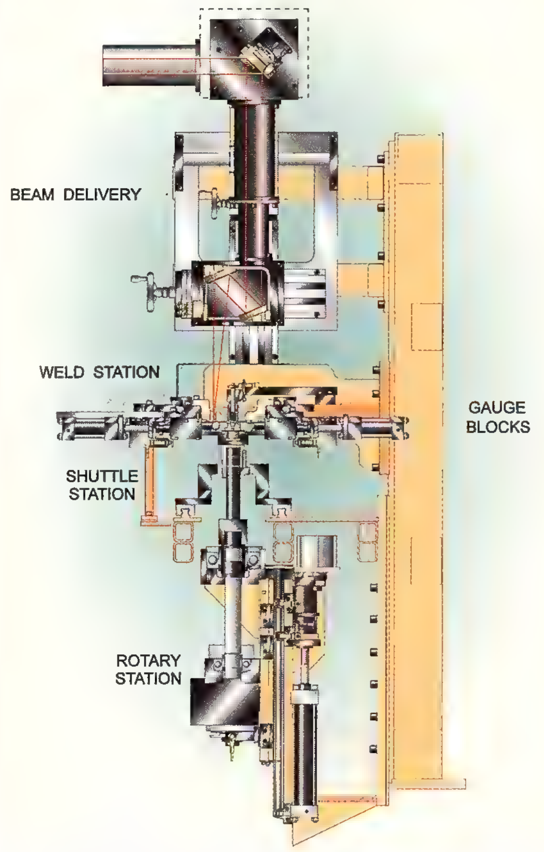
The introduction of MGS speed reducers and gearmotors in 1989 helped move Stober toward its global strategy, which was enhanced in 1991 when Stober Drives Inc., located in Maysville, KY, became the company's North American headquarters.

Stober's ServoFit line of precision planetary gearheads features Heli-Camber™ gear technology, based on advanced gear profile geometry, which significantly reduces backlash, gear noise, and wear while providing higher torque capabilities.

In addition, all planet gears are hardened and ground to eliminate any irregularities that may generate pulsations in the drive train, which can in turn lead to speed fluctuations.

Applications include robotics, plastic molding, and machine tools. Stober products are available worldwide—in the Americas, Europe, Asia, and Australia. **Circle 814**

Weld Station, Beam Delivery, Rotary Station and Shuttle (Side View)



Chrysler specified 100% weld penetration through material thickness from 3 to 5 mm and a production rate of four parts per minute for all of the ITP welding systems. DCT met the requirement with cycles at 12 to 13.5 seconds per part on all 11 ITP systems.

0.25 mm. After the gauge blocks are inserted, the fixture raises further to clamp the assembly and gauge blocks during welding.

At this point, the control system opens the laser beam shutter on the machine's 14-kW CO_2 laser. Energy is delivered through a system of water-cooled mirrors to the rotating part. An air knife protects the focusing optics during operation by preventing spatter contamination. By precisely placing a stream of inert gas at the surface of the weld joint, weld plume is reduced to prevent absorption of the laser beam.

An added feature of these laser welders is a high-intensity fume and particulate evacuation system used to clean both the atmosphere and the tooling. In other applications, DCT has found this feature reduces downtime for beam-delivery-system cleaning by removing most of the particulates before they can contaminate the lens. "It's analogous in function to the blow-off stations used on machine tools," explains Jurczyszyn. "Except that it collects the 'dirt' rather than simply dispersing it."

On the reverse carrier, as well as the other parts, Chrysler required 100% penetration of the welds with material thickness ranging from 3 to 5 mm. Chrysler specified a production capability of four parts per minute for all of the ITP welding systems. DCT met that requirement, and provided a small "cushion" with typical cycles in the 12 to 13.5-sec range on all 11 ITP systems.

While all the welding operations are similar in concept, some of the parts offer special challenges. For example, the overdrive clutch assembly requires that a cup-shaped stamping be welded to a prehardened steel shaft without annealing it.

Even more difficult, however, was tailoring the welding operation to achieve the required weld penetration of 100% without annealing the shaft. This was achieved by designing the flange to be wide enough to dissipate the heat before it reaches the shaft.

When the first 45RFE transmissions roll off the ITP production lines this year, they will represent a major advance in both transmission design and manufacturing technology. The 11 DCT laser welding systems in use at ITP will be the largest installation of its kind, if only for a short while. For even as the ceremonies surrounding Chrysler's newest facility are underway, DCT is at work filling an even larger order.

For more information

Welding systems from DCT . . . . **Circle 758**

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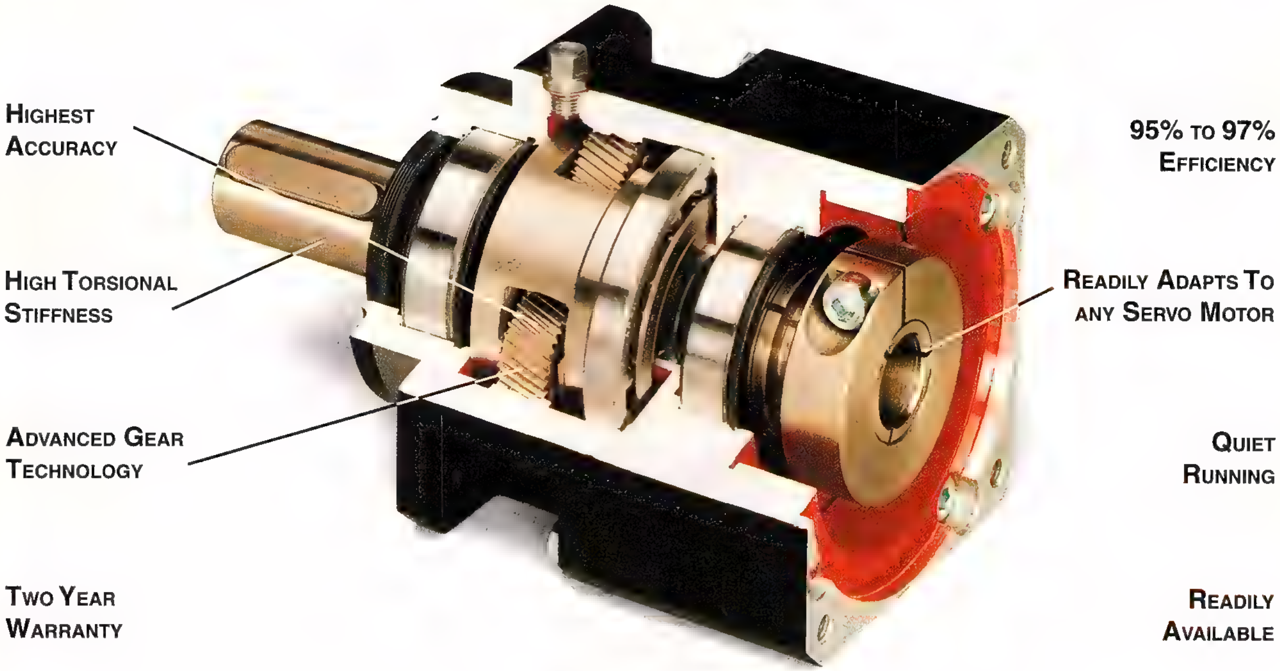

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Circle 814

Vendor-Supplied Case History

Controls/drives advance lathe performance

The GT300 lathe from Graziano Machine Utensili S.r.l. (Tortona, Italy) features a PC-based control system from Indramat, as well as other machine design innovations. The lathe reduces the time to machine a workpiece with speed capability up to 30 m/min on the X, Z, and Z2 axes, thus increasing machine productivity by 10%.

To offer these performance capabilities, the lathe uses Indramat's open-architecture, PC-based MTC200 plug-in CNC and PLC control modules, a PC-based human-machine interface, DIAX04 intelligent digital drives, and a frameless ac spindle motor—all integrated by Indramat's software package.

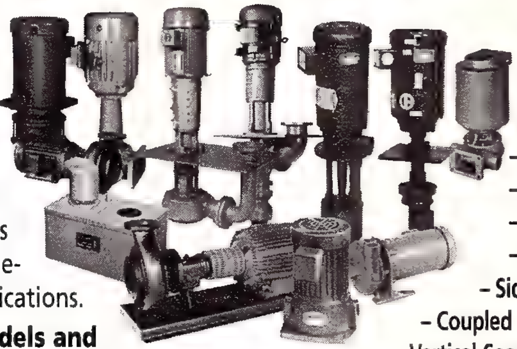
Graziano's lathe also incorporates a STONECAST base made from a special synthetic granite, and new slides incorporating ball bearings within linear guides. The GT300 uses the international standard SERCOS interface fiber-optic digital communications system for noise-immune, real-time communication between controls and digital drives. By closing the position loop in the drive itself, the drives achieve a 250-microsecond update time, providing extensive real-time monitoring of all operating data and diagnostics.

In addition to these features, Indramat's MTC200 family of CNC, PLC, and HMI modules are integrated as the machine console on the Graziano lathe. The control has an 850-Mbyte hard drive, and a color LCD monitor with interactive graphics that support programming for simple operation.

MTC200 modules control three different processes: machine programming, and operation and transmission of data and diagnostics to/from peripheral units. The SERCOS interface allows all internal drive data diagnostics to be input and displayed at the control terminal.

Indramat's intelligent DIAX04 digital drives provide direct ac line connectivity, eliminating the need for transformers and internal soft-start circuitry. The drives also feature a 700V dc bus.

The GT300 also used an Indramat frameless ac spindle motor to supply up to 14 kW of power at 6,000 rpm, with 130 Nm of torque. **Circle 815**



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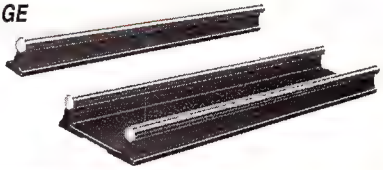

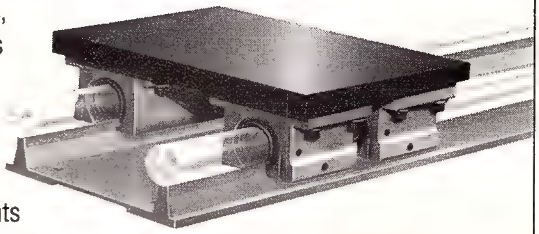

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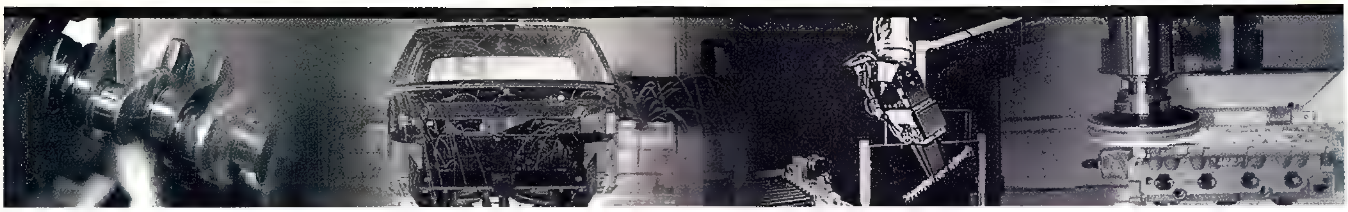

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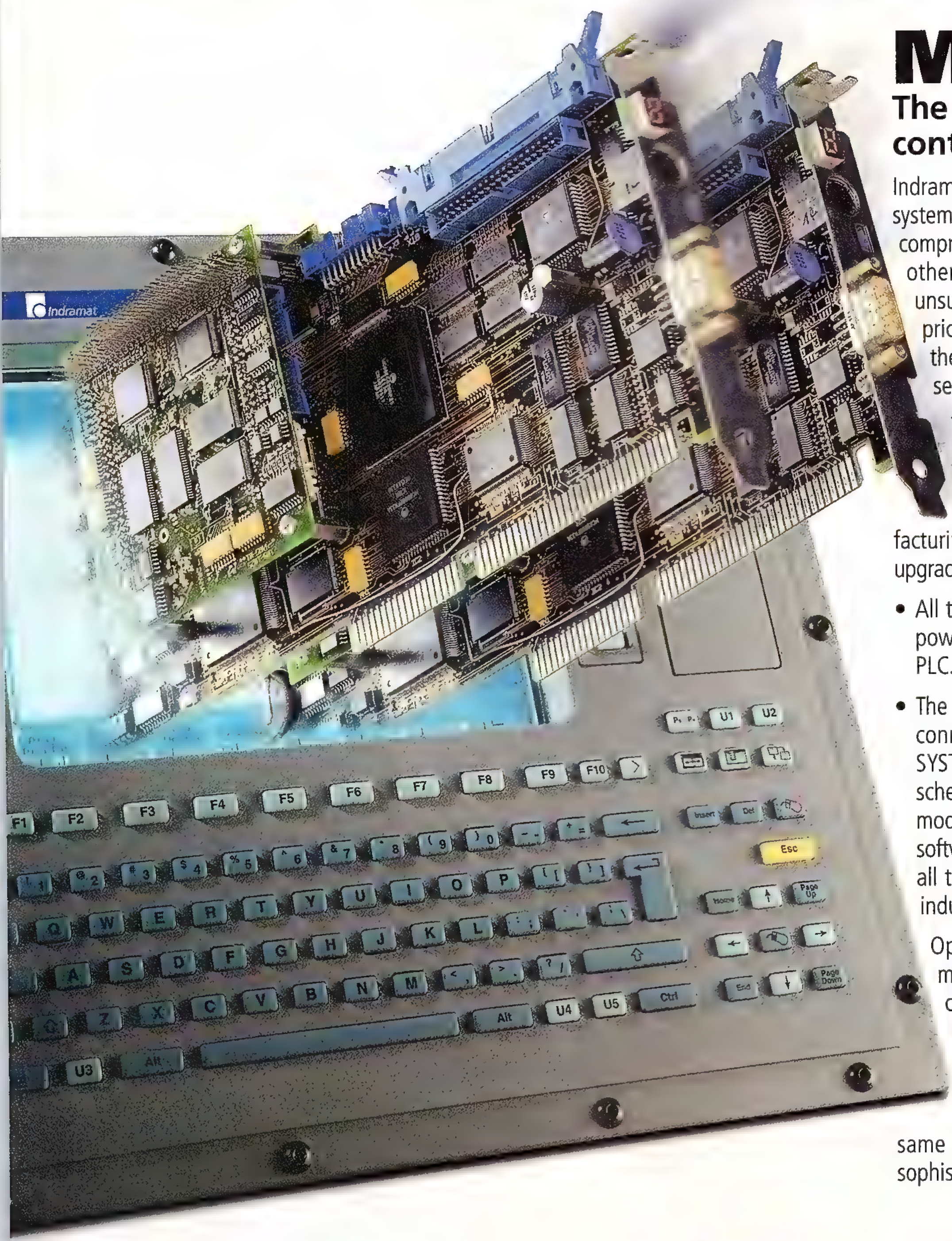

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Circle 815

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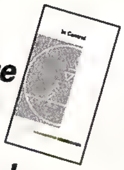

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Circle 846

The new look in machine tools

Simplicity is the name of the game

Laurie Peach, Associate Editor, *Design News*

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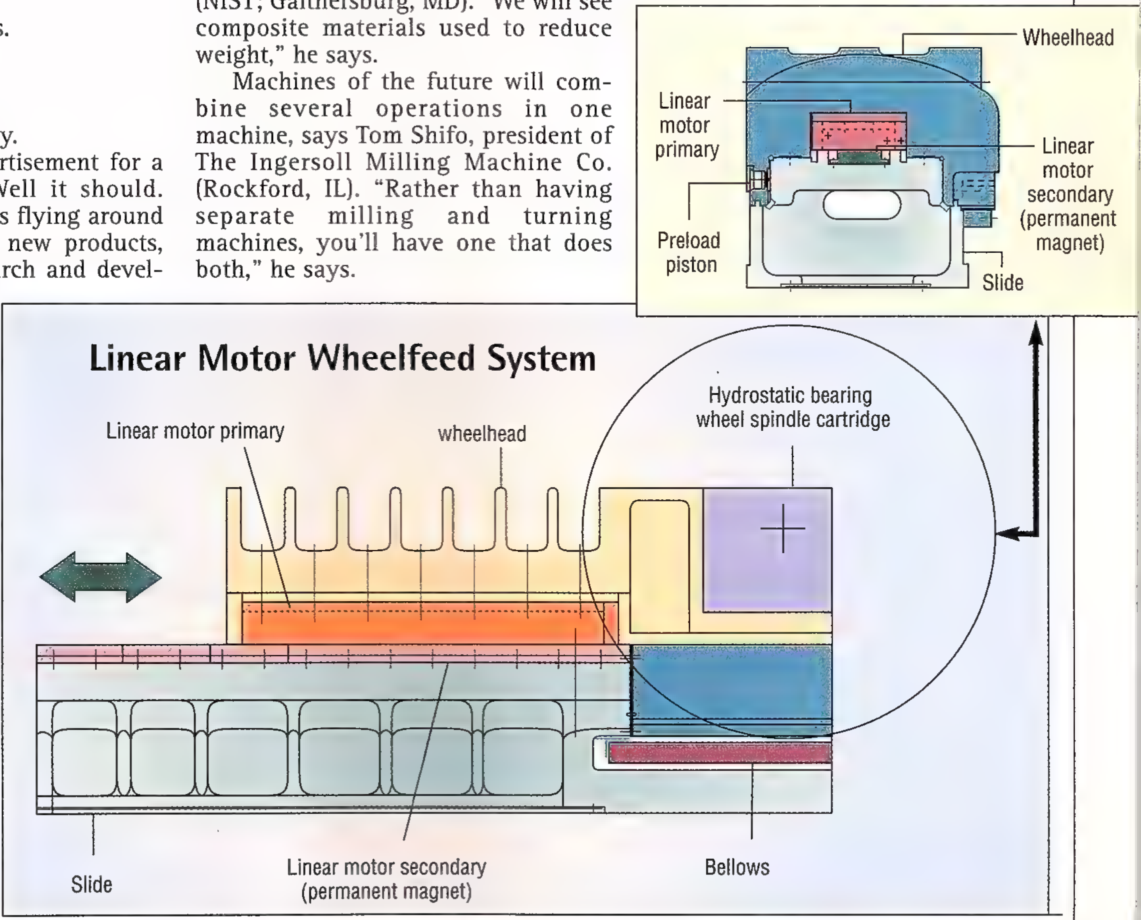
Sound like an advertisement for a new machine tool? Well it should. Those are the buzzwords flying around the industry to define new products, technologies, and research and development goals for machine tools for the 21st century. Whether one is discussing linear motors for grinding, super abrasive technology, or controls, companies are introducing products and researching technologies to meet these specifications on their customers' wish lists. Composite materials, better electronics, and more powerful PCs are the enabling technologies.

One of the more common trends, high-speed machining and tooling, will necessitate design and weight changes, according to Alkan Donmez, group leader in the Automated Production Technology Division within the National Institute of Standards and Technology (NIST; Gaithersburg, MD). "We will see composite materials used to reduce weight," he says.

Machines of the future will combine several operations in one machine, says Tom Shifo, president of The Ingersoll Milling Machine Co. (Rockford, IL). "Rather than having separate milling and turning machines, you'll have one that does both," he says.

"The world is seeking more simplicity," Shifo continues. Simplicity of design, be it controls or mechanical,


Wheelhead
Linear motor primary
Linear motor secondary (permanent magnet)
Preload piston
Slide
Linear Motor Wheelfeed System
Linear motor primary
wheelhead
Hydrostatic bearing wheel spindle cartridge
Slide
Linear motor secondary (permanent magnet)
Bellows

The Linear Motor wheelfeed system from Landis Gardner links the machine base and its driven components with a magnetic field, freeing the machine from the limitations of mechanical transmission elements.

VENDOR-SUPPLIED COMPANY PROFILE

Changing the rules of the game

Machine tool users are demanding faster, more reliable, more durable equipment. CERBEC® silicon nitride balls enhance performance and lower operating costs in machine tool applications. For many years, CERBEC balls from Norton Advanced Ceramics have enhanced spindle bearing performance with a focus on high rotational speeds. Today, hybrid bearings with CERBEC inside are being used for more than just higher speeds.

Compared to other steel balls, CERBEC balls are lighter, stiffer, smoother, harder, non-conductive, corrosion resistant, and more fatigue resistant. In a spindle, this leads to higher speed, increased rigidity, lower friction, less wear, reduced lubrication breakdown, and longer bearing service life. CERBEC silicon nitride balls exhibit 85% lower thermal expansion than steel. This minimizes skidding, reduces heat generation, and reduces contact angle change. Smoother CERBEC balls also reduce friction by 70%, which maintains lower operating temperatures, extends grease life up to ten times, and makes spindle bearings better and more durable. Specifying CERBEC inside machine tool spindles increases part output, quality, and machine up-time.

CERBEC balls also enhance the performance of machine-tool ball screws. High-speed machining means faster throughput, not just shorter cutting time. The movement of workpieces and spindles between cuts is critical and machine users are demanding faster linear motion to take advantage of advancing software and controls.

Ball screw manufacturers use CERBEC balls to enhance linear speed, stiffness, durability, and acceleration. They have been used in the wing flaps of the latest passenger aircraft. As a result, wing-flap ball screw manufacturers have quadrupled their warranty life to airlines. Machine-tool, ball-screw support bearings also incorporate CERBEC balls to enable faster ball screw speeds.

CERBEC balls are also used in electric motors for applications such as belt-driven spindles. As insulators, they eliminate arcing problems. This can extend the service life of bearings used in electric motors up to 10 times as compared to all-steel bearings. **Circle 818**

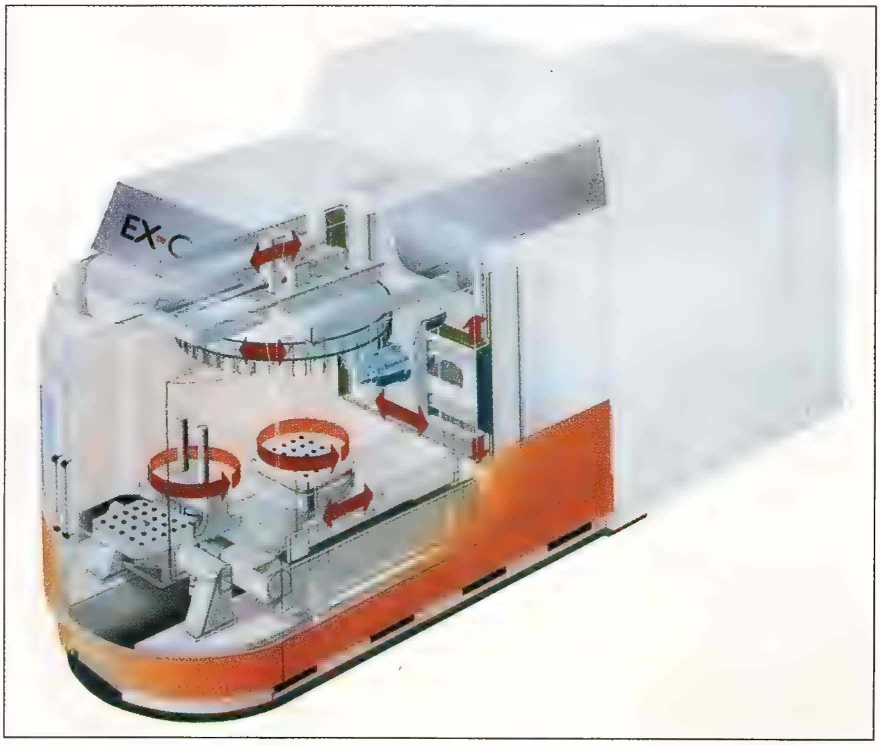
has a direct relationship to reliability and maintainability. For example, says Shifo, instead of a complicated gear train to drive a spindle, Ingersoll offers a high-range, high-horsepower motor that directly drives the spindle, eliminating gears, shafts, and bearings. "That's the design direction we are going," he says.

Chris Evans from NIST says there is still a lot of interest around the world in parallel linkage tools such as the hexapod. "But you will get different opinions from different people on such devices," he says. Case in point, NIST's Donmez says, "Everyone who expected hexapods to storm the industry may still have a bit of a wait. There are still engineering problems to overcome, although the concept is good."

Daniel Raab, vice president of engineering for the Giddings and Lewis Automation Technology Division (Fond Du Luc, WI), predicts parallel linkage machines will be used as effectors to handle the spindle. While a traveling column will accomplish large motions, the movement of the spindle in a limited area will be handled with a parallel linkage mechanism. A consortium of aerospace companies is currently evaluating the company's hexapod for the production of aerospace parts at the University of Nottingham, England. Engineers are also evaluating the machine for use in the molten dye industry. "It is basically fully operational and cutting metal in England," says Raab.

The major breakthrough for the next 10 years will primarily be in cutting tools, spindle technology, and controls, according to Mark Tomlinson, vice president of engineering at Lamb Technicon Machining Systems (Warren, MI), a Unova Company. He says today's machines are capable of running much faster, have higher cutting speeds, and higher acceleration rates. "The spindle in the machine has surpassed the technology available in cutting tools," Tomlinson asserts. "The industry must compensate for this by developing more reliable tools, such as low-cost diamond-coated drills, taps, and reamers."

Raab also expects to see an increased emphasis on metal removal rates. To address this need, Giddings and Lewis is increasing spindle speeds and torque capacity through-out their product lines. "I also foresee increased traverse rates accomplished by developments in ceramic ball screw technology



EXCELL-O plans to debut the XHC 241, its twin-spindle, high-speed machining center with a new generation control package, at IMTS this September.

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as well as the application of linear motors," he says. As companies strive to move maintenance to the operator level, Raab sees machine tool manufacturers increasing the diagnostic capability of individual machines. He also foresees an increase of remote diagnostics so the machine manufacturer will be able to monitor the machines.

LINEAR MOTORS

"Linear motors are the propulsion of the future," says Ingersoll's Shifo. "Now, almost all of our new machines incorporate linear motors because they make a substantial contribution to increased productivity." Shifo says Ingersoll's current linear motor machines move at 3,000 inches per minute, "and we're looking at even faster rates."

Linear motors link the machine base and its driven components with a magnetic field, freeing the machine from the limitations of mechanical transmission elements.

"Because these motors operate entirely with magnets or by electromagnetism, they're inherently more reliable than conventional mechanical systems," says William Pflager, manager of R&D at Landis Gardner (Waynesboro, PA), a Unova company. He adds that the motors eliminate the problem of drive-screw component wear, which can lead to error in the axis motion. Because of that, he says, linear motors can work in perfect harmony with linear encoder scales or a laser feedback system to give consistently accurate wheelhead positioning to very tight tolerances.

Landis applies linear motor technology to its line of 3L series CNC crankpin grinders. Traditional indexing crankheads or special indexing fixtures are gone. Instead,

Environmental concerns dictate design

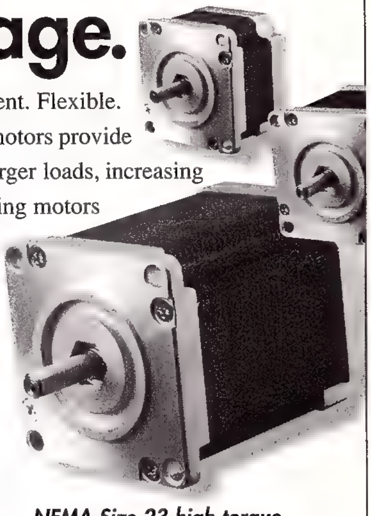
What's driving machine tool advances? Investment efficiency, says William Pflager, manager of R&D at Landis Gardner (Waynesboro, PA), which includes the usual issues of improved reliability and maintainability, and higher precision, as well as differences in processing because of changes in technology, including materials, reentry profiles, and part geometry. One of the newest drivers for machine tool developments is environmental compliance.

Government standards in the work place are driving people to tighter and tighter emissions standards. "This is becoming a critical issue in machine tools," says Pflager. "We as an industry have to clean up our act. A lot of people think environmental issues are all green house gases and pollution. But it comes down to machines we have to design.

"Environmental concerns will be one of the important issues driving our machines for the next 20 years," predicts Russell Kaiser, vice president of engineering at Landis Gardner. "This is what we have to address."

Higher cutting speeds and coolant pressures will require much more secure guarding in order to contain mist created by cutting and cooling processes, says Charles Carter, vice president-technology of The Association for Manufacturing Technology (AMT; McLean, VA). Since the cost of guarding for fluid containment is already significant, the industry can expect to see innovation in guard design and material selection.

Also, the introduction of more stringent safety standards in Europe will create well-defined procedures for documentation and warning signs that will become more international in application, says Carter.



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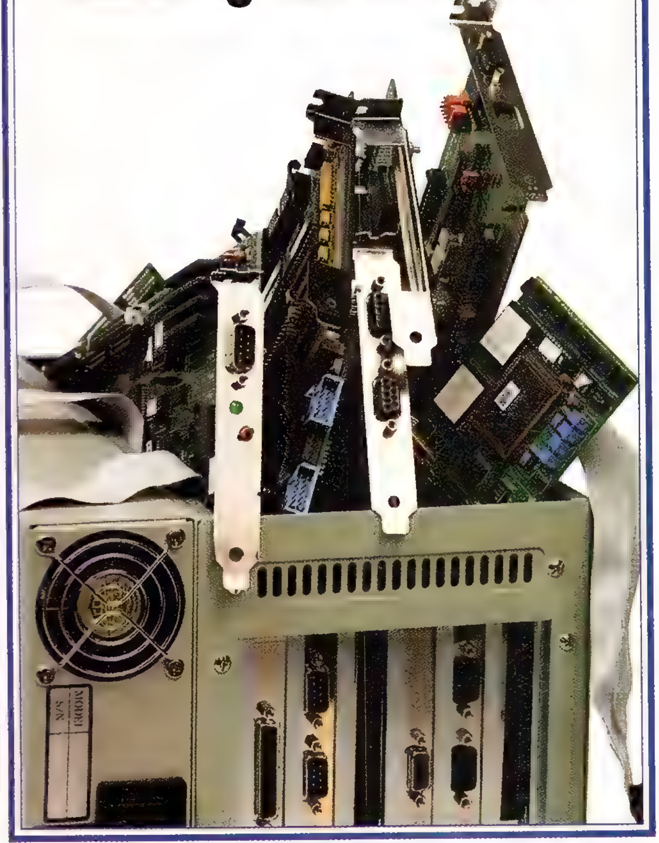
Circle No. 820

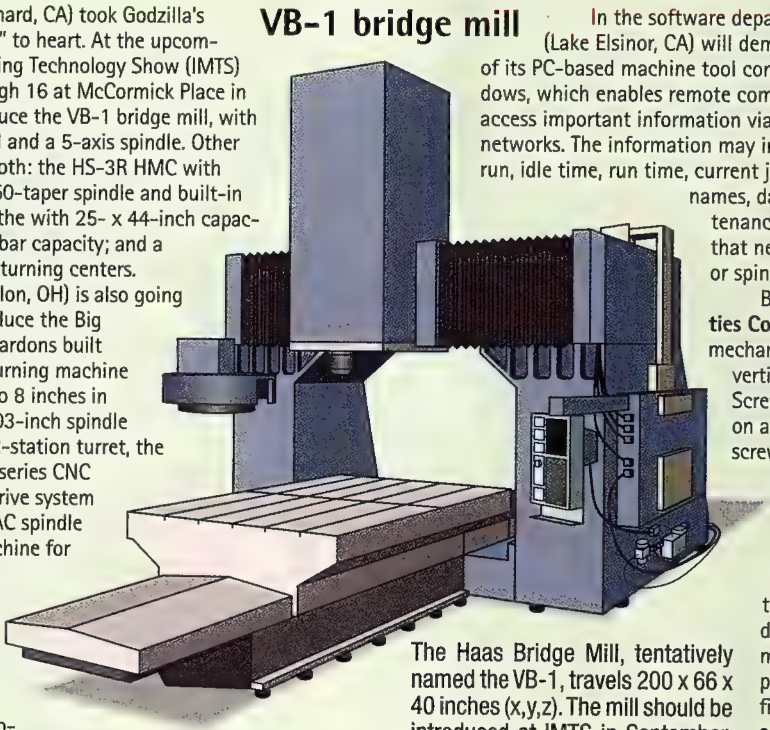
Running Out of Slots?



Circle No. 821

Size is everything at IMTS '98

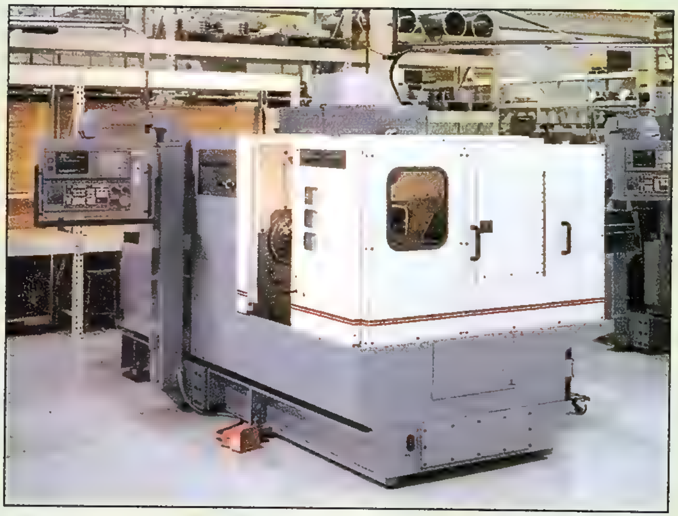
Haas Automation Inc. (Oxnard, CA) took Godzilla's motto, "size is everything," to heart. At the upcoming International Manufacturing Technology Show (IMTS) to be held September 9 through 16 at McCormick Place in Chicago, Haas plans to introduce the VB-1 bridge mill, with 200 x 66 x 40 inches of travel and a 5-axis spindle. Other products in the company's booth: the HS-3R HMC with 150- x 50- x 60-inch travel, 50-taper spindle and built-in 4th axis; the HL-6 big bore lathe with 25- x 44-inch capacity, A2-11 spindle and 6-inch bar capacity; and a bar feeder for HL-1 and HL-2 turning centers.



The Haas Bridge Mill, tentatively named the VB-1, travels 200 x 66 x 40 inches (x,y,z). The mill should be introduced at IMTS in September.

Bardons & Oliver Inc. (Solon, OH) is also going large. The company will introduce the Big Bore, 2SC-800, at IMTS '98. Bardons built the high-speed, 2-axis CNC turning machine to handle tubing and bar up to 8 inches in diameter. In addition to an 8.03-inch spindle bore, and a 1,600-rpm and 12-station turret, the machine has a GE-Fanuc 18I-series CNC control and digital AC servo drive system along with a 50-hp Siemens AC spindle drive. Bardons geared the machine for the automotive, bearing, and hydraulic cylinder industries.

For assembly, a new brazing machine will be on display from **Fusion Inc.** (Willoughby, OH). The rotary indexing system will braze two-piece assemblies at a rate of 400 per hour. Fusion says the key to the system's efficiency is a Fusion Paste Brazing Alloy, consisting of atomized fill metal, proper flux, and a paste binder blended together. The homogeneous mixture permits accurate measurement and eliminates the separate fluxing. In production, the operator loads the assemblies onto one of 12 machine fixtures. As the assemblies index clockwise around the machine, a positive-displacement applicator gun dispenses a pre-measured deposit of paste, brazing alloy onto the joint area. After paste application, the assemblies move through four natural gas-fired heating stations where the silver-based alloy is progressively heated to 1,200F. As the joined parts leave the final heat station, the molten alloy is cooled by compressed air and water stations before the parts are unloaded.



The Big Bore, a high-speed, 2-axis CNC Turning Machine from Bardons & Oliver, handles tubing and bar up to 8 inches in diameter. The 22,000-lb 2SC-800 is suited for both stand alone and cellular applications.

Hausermann Controls Company (Addison, IL) claims that "DC arcs are a thing of the past" with their latest CNC control. The new control features the company's neural-logic-based NDA circuit, a result of a three-year study co-sponsored by Hausermann, the Department of Energy, and Sandia National Laboratories to improve electrical discharge machining (EDM). The motion control system features Motorola's new family of 56300 digital signal processor ICs, and can control up to 32 axes in up to eight coordinate systems.

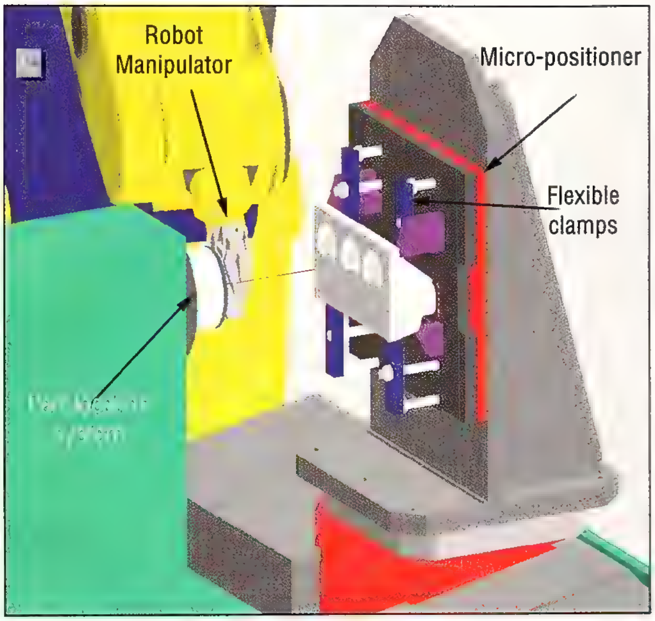
In the software department, **Camsoft Corp.** (Lake Elsinor, CA) will demonstrate the latest version of its PC-based machine tool controller software for Windows, which enables remote computers to automatically access important information via standard RS232 cables or networks. The information may include the number of parts run, idle time, run time, current job loaded, operators' names, dates, scrap parts, and maintenance reminders, such as filters that need to be changed, oil levels, or spindle maintenance.

Broaching **Machine Specialties Co.** (Novi, MI) will introduce a mechanical drive internal table-up vertical broaching machine, Screw-Mate. The device operates on an electro-mechanical roller-screw drive system instead of the more common hydraulic system. The company claims the roller screw drive affords a smoother cutting stoke than traditional hydraulically driven broaching operations, making the machine good for parts with stringent surface-finish requirements such as aerospace components. Broaching is also offering a new pull-down vertical-broaching machine called the Mini-Mate that the company says is suited for cell manufacturing systems. The open machine column allows for flexible automated part flow either across the face of the machine or through the machine frame itself.

Electro Arc (Ann Arbor, MI) will show QuickTap, a line of multi-spindle tapping machines new to the U.S. market. Stan Pylar of Electro Arc says these small production machines take maximum advantage of enhanced multi-spindle technology to take over multiple-hole tapping. IMTS visitors will see QuickTap turning out four holes tapped in six sides of a cube in three seconds per side.

Overbeck (Hauppauge, NY) will showcase its Model IC-400 grinding machine. It automatically grinds several bores, faces, tapers, and cams in one setting within the envelope of a 7-inch (maximum) bore diameter, 6 1/4-inch length, and outside work piece dimension of 10 x 10 inch. Rigid grinding spindles permit the use of CBN and diamond tools.

Another new face to the U.S. market, **Nicem S.P.A** (Senago, Italy), in conjunction with its U.S. representative, Frank Pertot Co., will exhibit Nicem's patented Wedge Lock System. The system allows rapid changing of separation grids on automatic unloading vibratory mills. Also on display will be an in-line plant used for deburring of parts.



The Intelligent Fixturing System, funded by the National Institute of Standards and Technology, will eliminate the need for mechanical cast locators using electromagnetic actuators.

they use a CNC-controlled wheelfeed mechanism that permits the grinding wheel to precisely "follow" the orbit of each crankpin as the crankshaft rotates about the centerline of the main journals.

SUPER ABRASIVES

Huffman Inc. (Clover, SC) is introducing the flight and industrial gas turbine industry to the multi-axis, contour-capable, CBN superabrasive grinding machine. "1998 is the first year since WWII that commercial aircraft has exceeded the military production of aircraft," says Roger Hayes, of Huffman. Many manufacturers still assemble aircraft like they put together the first metal ships, with rivets, he continues. "High-value-added parts on aircraft jet engines are ground to very tight tolerances by grinding wheels that are like the original mill stone or sand paper," he says. "The grit comes off."

Superabrasive grinders use a diamond-plated grinding wheel, or a man-made substrate called cubic boron nitrite (CBN). "This is replacing milling and even turning for making turbine blades, because you can actually finish-grind cast blades in one chucking," Hayes says.

CBN allows more productive grinding by permitting higher wheel speeds than conventional methods, he continues. Because of its hardness, the wheel doesn't wear. Superabrasive technology also uses smaller wheels than conventional methods, so more than one wheel fits in a machine. Several operations can be done on a part at once. "A part may even be completed with one machine," says Hayes. Traditionally, to finish a turbine blade, anywhere from 5 to 19 machines are required, he says. "It's more complicated from a programming side because we have to program our machine with 19 machines' worth of sense," says Hayes. But, he adds, this produces a much higher quality part than conventional methods.

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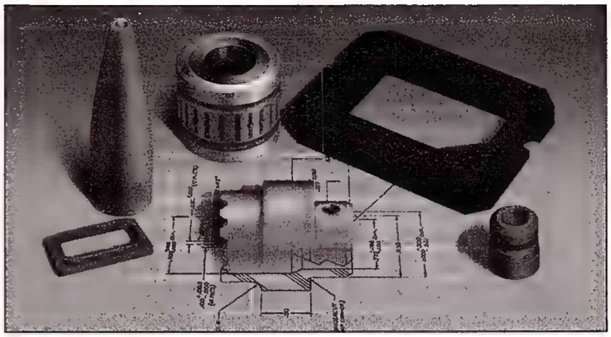

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VENDOR-SUPPLIED CASE HISTORY

Controller combines small size, benefits

Engineers at Technology 80 have succeeded in developing what they say is the industry's first full-featured motion controller which is compliant with PC/104 Specification Version 2.3. Called Model 5950B, this precision motion controller can be packaged in smaller spaces not possible before. Applications include packaging, machinery, robotics, and medical instruments.

The form factor requirement demanded the board measure 3.55 x 3.775 inches, and yet, the goal was to add functionality, flexibility, and user-friendliness to the design.

Precision control was a top design priority. As a result, engineers incorporated a 16-bit, high-precision monotonic DAC instead of using widely accepted audio DACs. According to the company, this provided linear accuracy. "It opens the door for higher precision applications with a board that can be packaged in smaller designs," says Marketing Manager Scott Wyman. Other motion controllers use inexpensive audio DACs which are not suited for instrumentation.

Building upon previous platforms, engineers expanded the robustness of the I/O. High-speed clamping diodes were used on the I/O, and extended the transient protection to be far more resistant to high-speed external spiking and noise than in standard motion controllers.

Configuration jumpers and adjustment potentiometers were eliminated. "This is a big advantage for users because the conventional functions are now factory set and/or stored in non-volatile memory on the board. Minimizing our customers' time for set-up and mistakes was an important criterion for us," say C.O.O, Jim Burkett. On-board LED's have also been eliminated, and accessibility is available via software.

The PMD 1401A DSP control chip with an enhanced custom I/O chip handles the servo algorithms with PID and velocity feedforward filtering for all four axes. It performs the intensive computational tasks required for high-performance applications such as digital velocity, torque, and position control. S-curve, trapezoidal, and velocity motion profiles are also available. **Circle 824**

CONTROLS

EXCELL-O President and CEO John S. Klimach says controls is the area to watch in the future. "Control technology has changed the most during the past decade and the 21st century will see even more changes," he says. "The control package will get smaller, more responsive, faster, and more reliable." The biggest problem, he continues, is reliability of electronic components, especially switches, because they are most susceptible to failure. "I want to eliminate as many switches as possible," Klimach asserts. Everything should be "self-contained. That is the direction we are going."

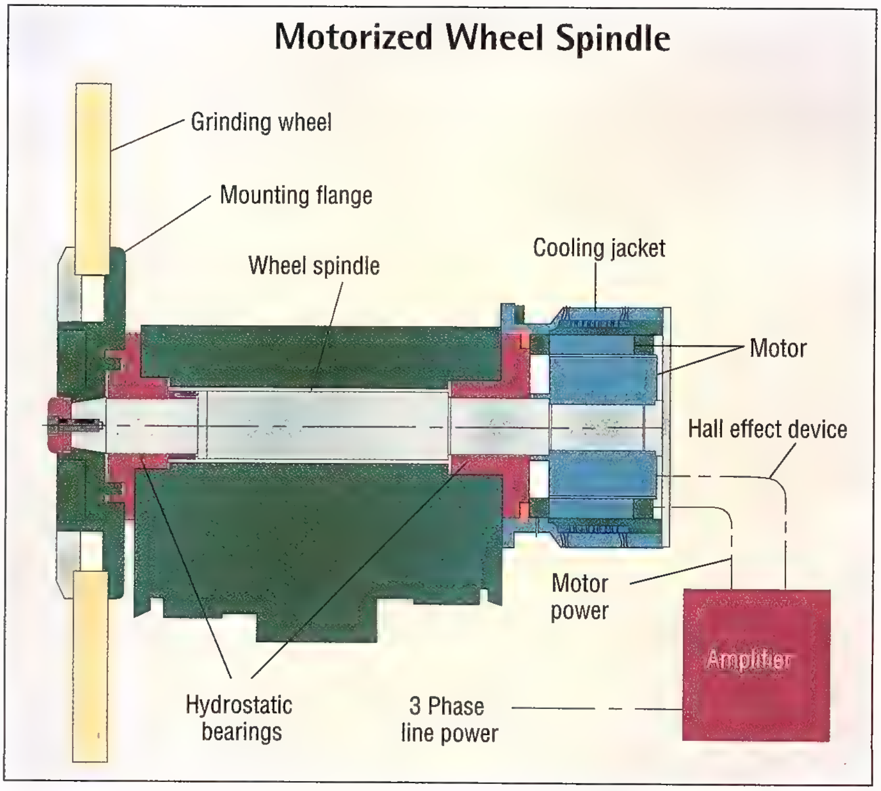
Many of the changes that are occurring in machine tools are possible because of more powerful and reliable controls, says Carter. Programmable logic controllers (PLCs) continue to grow in capability to the point where PLCs combined with motion control begin to look like CNCs.

Lamb's Tomlinson also sees a change in controls. "There is movement away from propriety components to generic control systems using PC-based systems, or open architecture so the machines can increase their modularity and be more interchangeable."

COMING ATTRACTIONS

Lamb, in conjunction with Georgia Tech, Penn State, the University of Illinois, and the University of Michigan, is developing the Intelligent Fixturing System (IFS), capable of locating and holding parts in order to eliminate the need for mechanical cast locators. A prototype, expected within the next two to three years, will be reconfigured to accommodate multiple parts within a specified part family. It will have a monitoring system capable of detecting departures from intended positions, the intelligence to make corrections, and a sufficient fixture-part rigidity to allow aggressive cutting while minimizing vibration and assuring precise machining.

The plan is to provide additional axes of movement in the fixture through electromechanical actuators, says Tomlinson. A mechanical actuator and fixture, along with a measuring system, will determine where the part is located. The system used to measure the part will determine how many axes



New motorized wheel spindles from Landis Gardner offer hydrostatic bearings instead of conventional bearings. These spindles have no external forces such as belts or pulleys.

of movement must take place to get the part to the correct plane. Three translational axes of movement will be in the machine itself, and two rotational degrees of freedom will be in the fixture. The machine tool controller will provide the third rotational degree of freedom through coordinate transformation. Lamb hopes to integrate the IFS into flexible production automotive-part machining systems.

Lamb engineers at Hansberg Lamb (Germany) are collaborating with other German machine tool manufacturers on the "M" machine, a device Tomlinson calls a non-traditional approach to 3-axis machining. Resembling the letter M, it uses a combination of pivot points to move the spindle in two of the three planes. Z-plane movement is still done through conventional methods. It becomes a much simpler machine by using pivot points, says Tomlinson, and it is lighter and less complex. "Right now, it is just a concept. A prototype is a good two or three years away. We are determining the commercialization process now."

Engineers at Landis Gardner have developed motorized spindles to eliminate all pulleys, belts, and gears traditionally required to drive a spindle, says Pflager. The rotor is mounted directly on the spindle and the two act as one device. "This is a tremendous advantage in that it reduces all vibrations, cost, and ultimately cost to customer," says Pflager.

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For more information

3L series CNC crankpin grinders from Landis Gardner	**Circle 759**
CBN grinding machine from Huffman Inc.	**Circle 760**
Intelligent Fixturing System from Lamb Technicon Machining Systems	**Circle 761**
M machine from Lamb Technicon Machining Systems	**Circle 762**
VB-1 bridge mill from Haas Automation	**Circle 763**
Big Bore 2SC-800 CNC turning machine from Bardons & Oliver Inc.	**Circle 764**
Brazing machine from Fusion Inc.	**Circle 765**
CNC control from Hausermann Controls Company	**Circle 766**
Machine tool controller software from Camsoft Corp.	**Circle 767**
Screw-Mate broaching machine from Broaching Machine Specialties Co.	**Circle 768**
QuickTap multi-spindle tapping machines from Electro Arc	**Circle 769**
IC-400 grinding machine from Overbeck	**Circle 770**
Wedge Lock System from Nicem S.P.A	**Circle 771**

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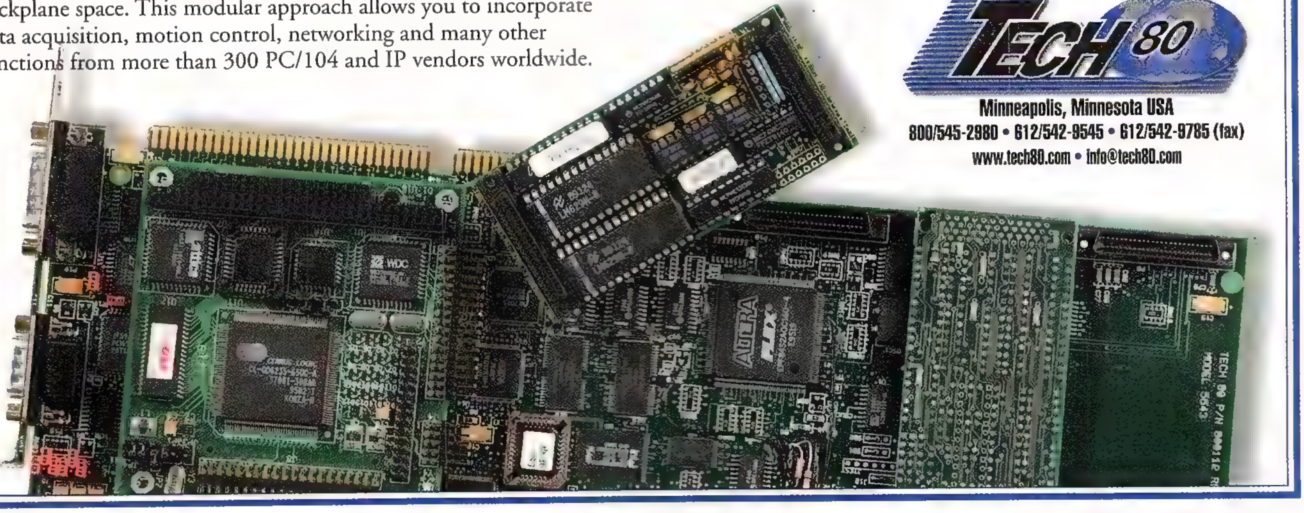
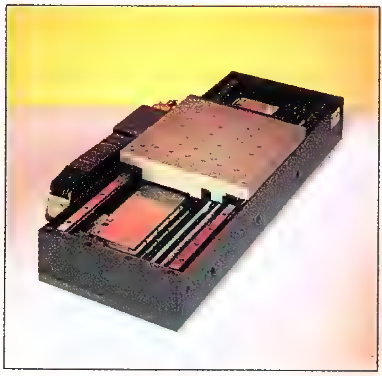
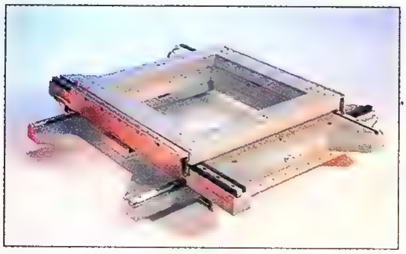


Circle No. 824

AEROTECH

Motion Control Products and Positioning Systems





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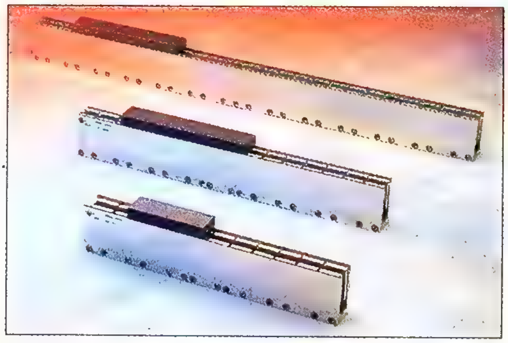

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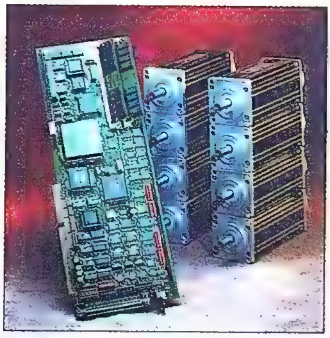

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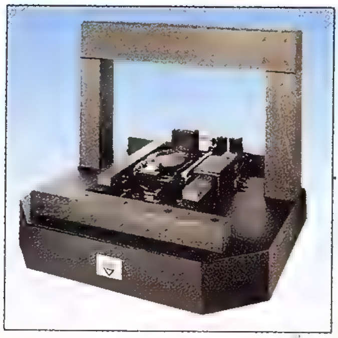

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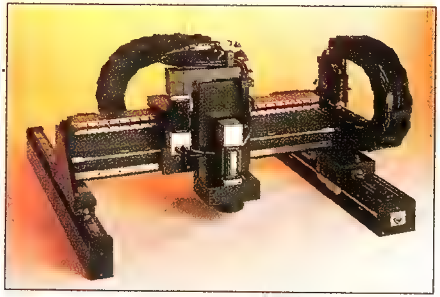

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Automated carbon-fiber placement *reaches new heights*

New machines enable use of advanced composites in aircraft design

John Lewis, Technical Editor, *Design News*

Light weight. High strength. Composite parts excel in high-tech R&D, military, and commercial industries. Even in the face of prevailing, yet decidedly unproductive, manual lay-up techniques, carbon-fiber costs continue to come down as supply and demand grow. Although advances in materials and automated processing equipment open up new opportunities for composites in aircraft stabilizers, wing skins, and airfoils, many obstacles remain.

For example, conventional tape-laying machines limit part geometries to gentle contours. Filament winding machines can leave gaps in concave surfaces, require geodesic wind patterns, and produce large variations in wall thickness that often require subsequent machining, and yield inconsistent part-to-part quality. Cincinnati Milacron's (Cincinnati) Viper Fiber Placement System (FPS) bridges the gap between conventional filament winding and contour tape-laying machines—increasing design options while cutting waste and cycle time.

In aerospace, automated production of highly contoured parts such as spars, fan blades, inlet ducts, and fuselage sections is possible. Take Raytheon Aircraft's (Wichita, KS) Premier I and Hawker Horizon business jets for example. Both use composite fuselages made on a Viper FPS. Special software, called Acraplace, generates programs to precisely control seven servo-driven axes through the Acramatic 975F CNC. The CNC, specifically developed for fiber placement, controls the 24-tow fiber placement head over contoured, convex, and concave surfaces.

Minimize gaps and laps. Viper operation at Raytheon is controlled by the Milacron-designed-and-built CNC. It uses multiple microprocessors in a bus-type control system. An integrated programmable controller serves as interface to the machine and process. The Viper fiber-placement head individually cuts each tow and feeds or restarts it as required to minimize gaps and laps, even as the head steers the tow over the tool surface in non-geodesic paths with small in-plane radii. "Given the huge complexities in part geometries and machine positioning, we knew that programming ease was critical to performance," says Supervisor of Cincinnati Milacron's Software Products development group Jay Hissett.

"By automating part production with the Viper, we have realized huge improvements in

Computer image of Raytheon Aircraft's Premier I entry-level business jet and the Hawker Horizon super mid-sized business jet: Both have composite fuselage designs produced on Cincinnati Milacron's Viper fiber-placement system.

VENDOR-SUPPLIED COMPANY PROFILE

Robotic systems improve loading

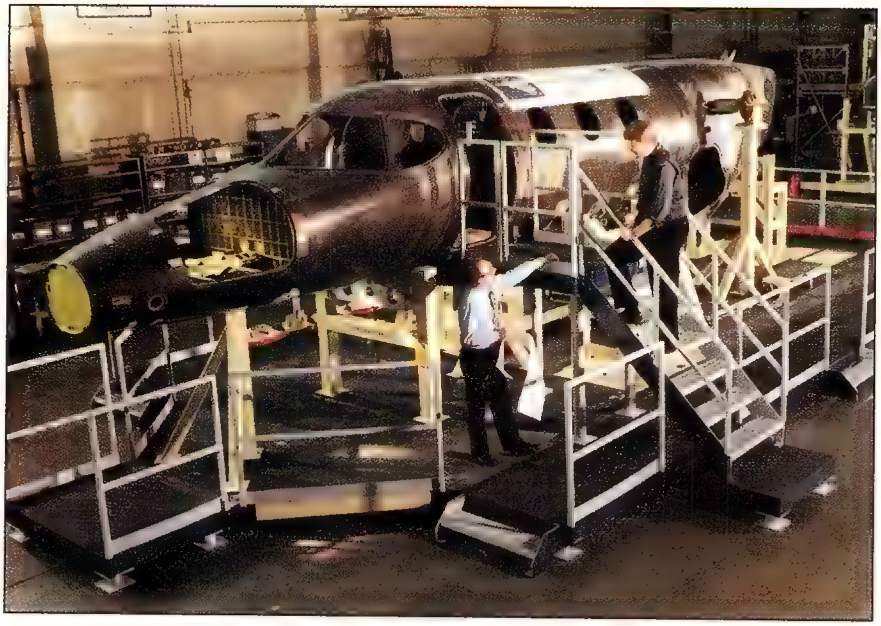
Loading 70-lb camshafts measuring 42 inches in length into vertical induction furnaces can be extremely dangerous when done manually or with a jib crane. The camshafts have many sharp edges and the furnace coils can be damaged if touched by the camshaft.

ABB Flexible Automation recently installed an IRB 6400 robot, equipped with a dual gripper, to handle this operation. The sequence of operation is as follows: the robot unloads one or two completed camshafts from the furnace and transfers them to an outgoing conveyor. The robot then picks up either one or two new camshafts from an incoming conveyor and transfers them to the furnace.

Throughput of the system is entirely dependent on the heat-treating cycle of the camshaft. Another major parameter of the cell: It had to include plans for an additional induction heat-treat furnace in the future. This meant that the gripper design and a planned increase in the production of camshafts had to handle a much smaller camshaft since no changeover in tooling for the new camshaft would be allowed.

Although slightly easier than handling 70-lb camshafts, inserting cylinder liners into an engine block is also considered a difficult manual process due to ergonomic issues such as weight, lifting, and the reach required to handle this task. One heavy-truck manufacturer addressed this challenge by installing a robot to insert the correct liner.

The engine block delivered to the robot and the manufacturer's control system downloads the correct size of liner required for the robot controller. The robot then selects a liner from the conveyor system and measures the liner bore. The robot gripper verifies that the liner bore is the correct measurement. If correct, the IRB 4400 robot inserts it into the engine. If the robot determines the liner bore to be incorrect, the robot then sends the liner to a "reject" conveyor. These parts are not considered actual "rejects," but parts required to assemble a different size engine. When a different size engine is delivered to the robot, these parts are reintroduced to the robot. **Circle 826**



First forward and aft fuselages of Raytheon Aircraft's Premier I were mated at the company's Plant Three manufacturing facility earlier this year. Flight testing begins this summer. FAA certification and first customer delivery are expected in the summer of 1999.

productivity and costs," says Raytheon Aircraft's VP of Operations Richard Danforth. Production of the Premier I is different than any modern business aircraft. To ease access for the assembly crews and decrease systems installation and inspection time, the airplane's composite fuselage sections are joined as late as possible in the production cycle.

The Viper produces each forward and aft fuselage in one piece. The system automatically lays epoxy-impregnated carbon fibers on a rotating mandrel or tool surface. After the first layers of carbon fiber are in place, Nomex™ honeycomb material is used to create the structure's core. This is covered with more layers of carbon fiber that are placed over the honeycomb, creating a "sandwich" construction that provides outstanding strength and a larger cabin interior.

Viper lets Raytheon Aircraft offer exceptional performance, comfort, and value in Premier I, the company says. The airplane's swept-metal wing design and all-composite fuselage provide a large, six-passenger cabin in an aircraft that will fly at 0.8 Mach cruise speed and offer travelers a 1,500-mile range at long-range cruise.

Fewer parts, larger interior. According to Mike Viscosi, group manager at Raytheon's Plant Three manufacturing facility, the cycle time to build a forward fuselage is about one week from start to finish if you work two shifts. The rear fuselage takes a little less than a week. Two parts make up the fuselage on the Premier I, vs. thousands of stringers, ribs, and skins on a similarly sized aluminum aircraft.

Not only does composite fuselage design significantly reduce the number of parts, but it also yields greater interior volume than a similarly sized aircraft built with conventional aluminum construction. "If you look at the cross section of an aluminum structured aircraft," says Danforth, "generally you lose three inches on the inside fuselage diameter, as opposed to less than one inch with a composite design."

Viper's one-step process compacts tows on a rotating or non-rotating mandrel or tool surface, creating flat, convex, concave, or compound geometrical shapes with reduced intermediate compacting or vacuum debulking operations. The system is many times faster than techniques requiring hand lay-up and, generally, far more productive than current automated systems. Viper produces parts to near net shape. It places tows around cutouts if desired, and starts and stops plies at pre-programmed boundaries. It maintains constant wall thickness even as the part diameter varies, reducing material use by up to 40%.

The width and length of the fiber band vary during the process to optimize part characteristics and cycle

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■ **VENDOR-SUPPLIED COMPANY PROFILE**

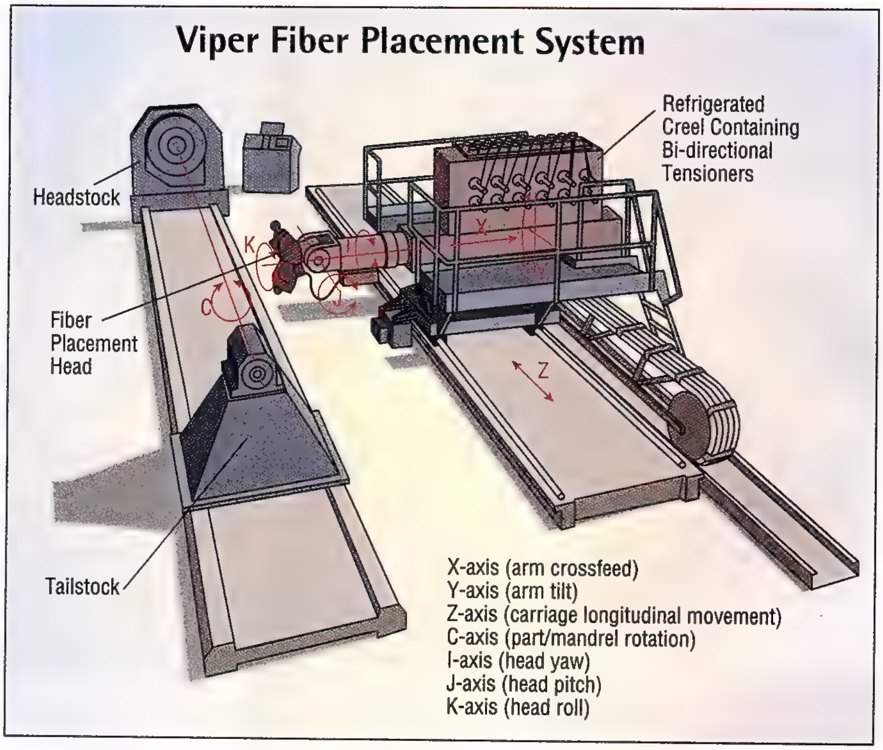
Screws yield growth

Nook Industries (Cleveland, OH) manufactures linear motion components and linear systems for use in straight-line, controlled-movement applications. Recognized worldwide as an innovative and responsive organization, Nook products are designed, manufactured, and delivered on time, meeting customer specifications and expectations. Nook's customers include transportation, electronics, packaging, steel, medical/diagnostic, paper, chemical, food/beverage, and communications markets.

Founded in 1969 by Joseph H. Nook, Jr., the company originally stocked and machined GMC Ball Screws. In 1975, Nook began to manufacture its own line of products which began with the introduction of Powerac® acme screws, nuts, and mounting flanges. In subsequent years other lines were added: ActionJac® worm-gear screw jacs; PowerTrac® ball screw products; ActionJac® electric cylinder actuators; and PowerTrax® linear slide systems and components. The most recent addition to the Nook line of products is Powerac Plus® screws and pre-loaded nuts.

Nook uses the latest technologies to make products that satisfy the needs of the market, while continually striving to increase efficiencies and productivity. Recently, Nook purchased an 80-ft-long thread-rolling machine to manufacture screws with lead accuracies of 0.004 inch/ft to meet the increase in demand for heavy-capacity actuators and large-diameter screws. This machine can meet length requirements for almost any application, rolling bars up to lengths of 40 ft.

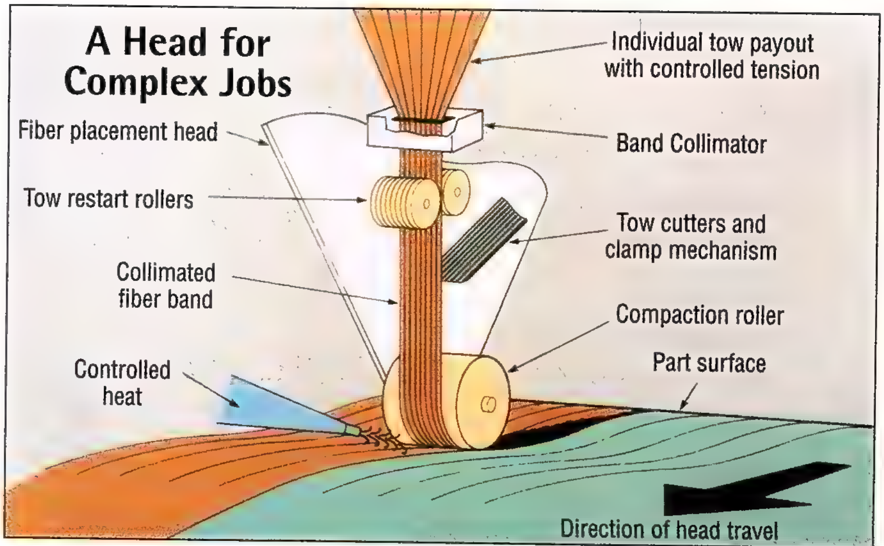
Nook Industries' expertise in thread forming allows it to produce a broad-size range of precision-thread lead screws for ball screw and Acme screw applications. Recognized for accuracy and durability, the company's ActionJac® worm-gear screw jacs use lifting shafts made by this thread rolling technology. In addition to hardened lifting screws, ActionJac® products feature longer bearing sleeves, and ductile iron housings, as well as matched and ground worm gears. **Circle 827**


Viper Fiber Placement System

Cincinnati Milacron's seven-axis Viper fiber-placement system automatically lays epoxy-impregnated carbon fibers on a rotating or non-rotating mandrel or tool surface, creating flat, convex, concave, or compound geometrical shapes

times. For example, as the part narrows under the Viper's placement head, the program signals that one or more tows should be cut off. Conversely, as the part widens, the program directs the head to feed out a greater number of tows as required. Viper can place a full width band of twenty-four 1/8-inch tows or slit tape just as easily and precisely as it can laminate a single tow onto the mandrel.

A head for complex jobs. The Viper's fiber placement processing head dispenses and individually controls up


A Head for Complex Jobs

Viper's placement head dispenses and individually controls up to 24 prepreg carbon-fiber tows. These tows, each 1/8-inch wide, can be collimated into a continuous fiber band up to 3 inches wide with virtually unlimited length.

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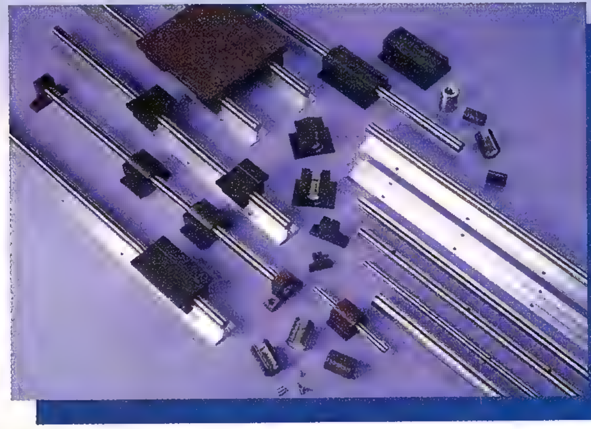

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Circle 827

VENDOR-SUPPLIED COMPANY PROFILE

Embeddable accelerometer debuts

Oceana Sensor Technologies Inc. (OST), a PCB Group company, has three new series of accelerometers for use with products like industrial rotating machinery, seismic vibration-monitoring systems, and acoustic stringed instruments.

The experience that OST has drawn from the Industrial Monitoring Instrumentation (IMI) Div. of its sister company, PCB Piczotronics Inc., has prompted the development of the new Pitbull™ embeddable accelerometer. High-resolution, piezoceramic, shear technology maintains comparable performance within a TO-5 transistor-style package suitable for embedding within machinery. Introducing the sensor internal to the machine at the OEM level eliminates the need for rugged, stainless-steel housings necessary for external installation, and allows for placement closer to the bearings and gears, which are the typical sources of machinery failure. Its extremely high resolution and broad bandwidth allow for detection of low-amplitude, high-frequency signals associated with bearing and gear failure.

The new Tremor™ Series addresses the low-frequency and high-resolution requirements of seismic monitoring systems. As structures like buildings and bridges deteriorate over time, it is important to assess their condition prior to catastrophic failure. Multi-sensor-based arrays monitor and trend the structure's response to environmental conditions. With quasi-static response and a broadband resolution of 30 µgs, the Tremor translates the necessary real-world information into a standard +/-5V dc signal.

For musicians who play stringed instruments, the Acoustic Performer™ piezo-pickup offers exceptional bandwidth characteristics, low noise, and low-impedence output. The AP206C is a TO-5 transistor-packaged accelerometer with an integrally potted, two-conductor cable assembly that, when coupled to the bridge plate of an acoustic stringed instrument, transforms the instruments natural tonal quality into a high-fidelity analog signal. **Circle 828**

Raytheon Aircraft's fiber placement system in action, fabricating the outer layer of carbon fiber for the first Premier I forward fuselage.

to 24 prepreg tows. These tows can be collimated into a continuous fiber band up to 3 inches wide with virtually no limit on length. The head pays out one or more tows from the modular creel. Programmable bi-direction tensioners electronically control the tension of each tow as it is paid out or retracted. Tow tension can be automatically changed in-process as dictated by the part program on a per-ply basis.

Each of the dispensed tows can be cut, clamped, and restarted as needed during the placement process. This dynamic process control helps the Viper minimize gaps and overlaps and gives it the ability to precisely lay interior or exterior contour boundaries. The results: Quality, productivity, and material utilization increase, and manual lay-up and trimming operations are greatly reduced.

Mounted on the head is a compaction roller that laminates the tows onto the layup surface. This in-process debulking removes trapped air and helps eliminate small gaps between individual plies, boosting part quality. And the roller's high conformance capability prevents bridging on convex surfaces. Because not all banded composite materials have the same tack properties, the patented Viper head provides for tow cooling and heating. Heat is decreased during cut/clamp/restart operations to minimize resin pickup, then heat is applied at lay-down to improve lamination and surface consolidation. Heat application is pro-

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Circle 828

■ **Vendor-Supplied Company Profile**

Company builds to user requirements

The quick motion of a tool changer, a high-speed spindle with low vibration, and the smooth operation of an axis drive are some demands faced by machine tool builders. Today's machine designer builds machines that are more productive, and looks for a supplier or partner with experience in high-performance motion control to assist in these diverse applications. Kollmorgen has been providing axis and spindle-motor solutions for more than forty years, and in the early seventies, it put electric servomotors on hydraulically controlled machine tools.

"Understanding the requirements of the machine builder is critical," says Tom England, director of marketing at Kollmorgen. "We design a product line based on what the customers needs. Then we're there to help them with an extensive applications-engineering staff." An example of this is the V Series induction motor and VECTORSTAR™ amplifier system, designed for high-accuracy spindle and high-power servo applications. The V Series motor has smooth operation to speeds of 12,000 RPM, and its rapid acceleration provides more-accurate control of machine-tool spindles to increase production throughput.

Linear motors are now providing new solutions to traditional mechanical assemblies for many machine tool applications. PLATINUM™ DDL (Direct Drive Linear) motors integrate directly and according to the company, deliver high speeds and accelerations with smooth, error-free motion.

Kollmorgen also offers products that control single-motion or coordinate a variety of complex-rotary and linear motors.

Another important consideration is sizing and selecting a motion system for the machine. MOTIONEERING™ software allows a machine designer to choose an application; define a motion profile; and select a servomotor, amplifier, and power supply. **Circle 829**

portional to the layup rate.

The Viper head, designed for easy maintenance, opens easily, says Milacron. This speeds removal of carbon-fiber dust and resin particles that may accumulate and obstruct tow motion. Built-in control diagnostics further reduce unnecessary down time.

Viper is pioneering technology that the company says could profitably automate production of an incredibly wide variety of advanced composite parts. Combining machine tool rigidity and robotic dexterity, the Viper FPS expands the range of part geometries that can be produced with consistent quality by a single machine. Milacron says FPS is the first such machine to be awarded U.S. and foreign patents. Among other attributes, the company says, it:

- Combines the advantages of filment winding, contour tape laying, and in-process lamination with robotic characteristics, computer control, and off-line software.

- Provides uniform wall thickness in-process as the diameter of the part changes. This saves time and material.

- Automatically compacts fiber tows on non-geodesic paths to reduce subsequent machining which degrades part strength.

- Uses a distributed control system that employs tool center-point motion control. Simply put, this is programming and motion control base around a defined point in space—the tool center point—rather than movements in each axis. In other words, rather than calculate and describe the specific axis moves required to produce the desired motion, you simply define the path of the tool center point, or compactor, and let the system figure out the motions of the individual machine axes. This control method enables the Viper to maintain constant head orientation over the course of a programmed move.

- Supports the greater computation requirements of the fiber placement process with a complete, off-line software system.

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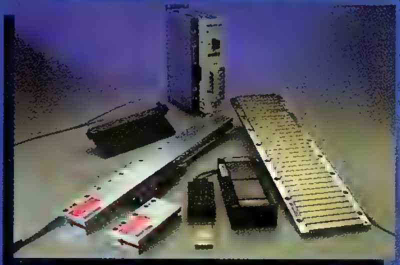

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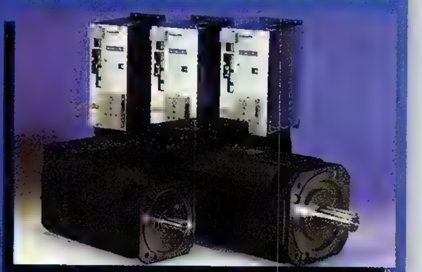

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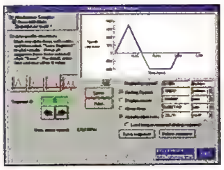

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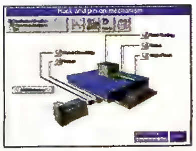

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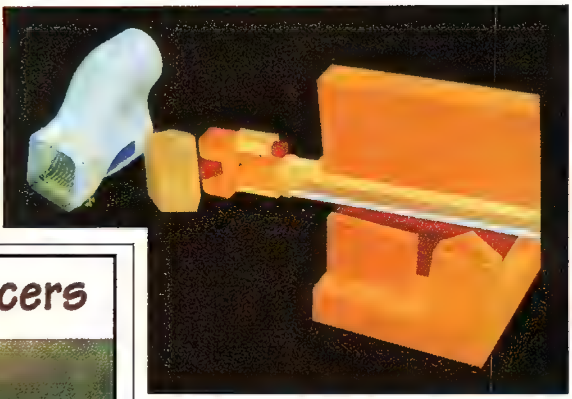

A simulator module in the Acraplace fiber-placement control software permits viewing the path of prepreged carbon-fiber tows and the placement head. Using a mouse, engineers pan and rotate the image and zoom in to view individual tow placement.

Because its first Viper installation went so smoothly and performed so well, Raytheon Aircraft plans to install two more Viper systems—configured with secondary head stock and tail stock—in the next few years.

The company has taken more than 100 firm orders for the Premier I entry-level jet. But it doesn't end here. Raytheon Aircraft's new super mid-sized jet, the Hawker Horizon, also uses a composite fuselage, only a one-piece design. Developed for manufacture on the Viper, the Horizon's composite passenger cabin reportedly provides a large-cabin jet for a mid-size cabin price.

Horizon will be typically configured with eight seats and may be configured for up to 12 passengers. The cabin has a flat floor running the full 28.9 ft length and features 72-inches stand-up head room. At the rear of the cabin is a large, 105-cu-ft baggage compartment that is accessible during flight.

With a maximum cruise speed of Mach 0.84 and a maximum range of 3,400 nautical miles, the Horizon has trans-Atlantic capability. The aircraft's first flight will take place in late 1999, with certification and first customer deliveries scheduled for spring 2001.

For more information

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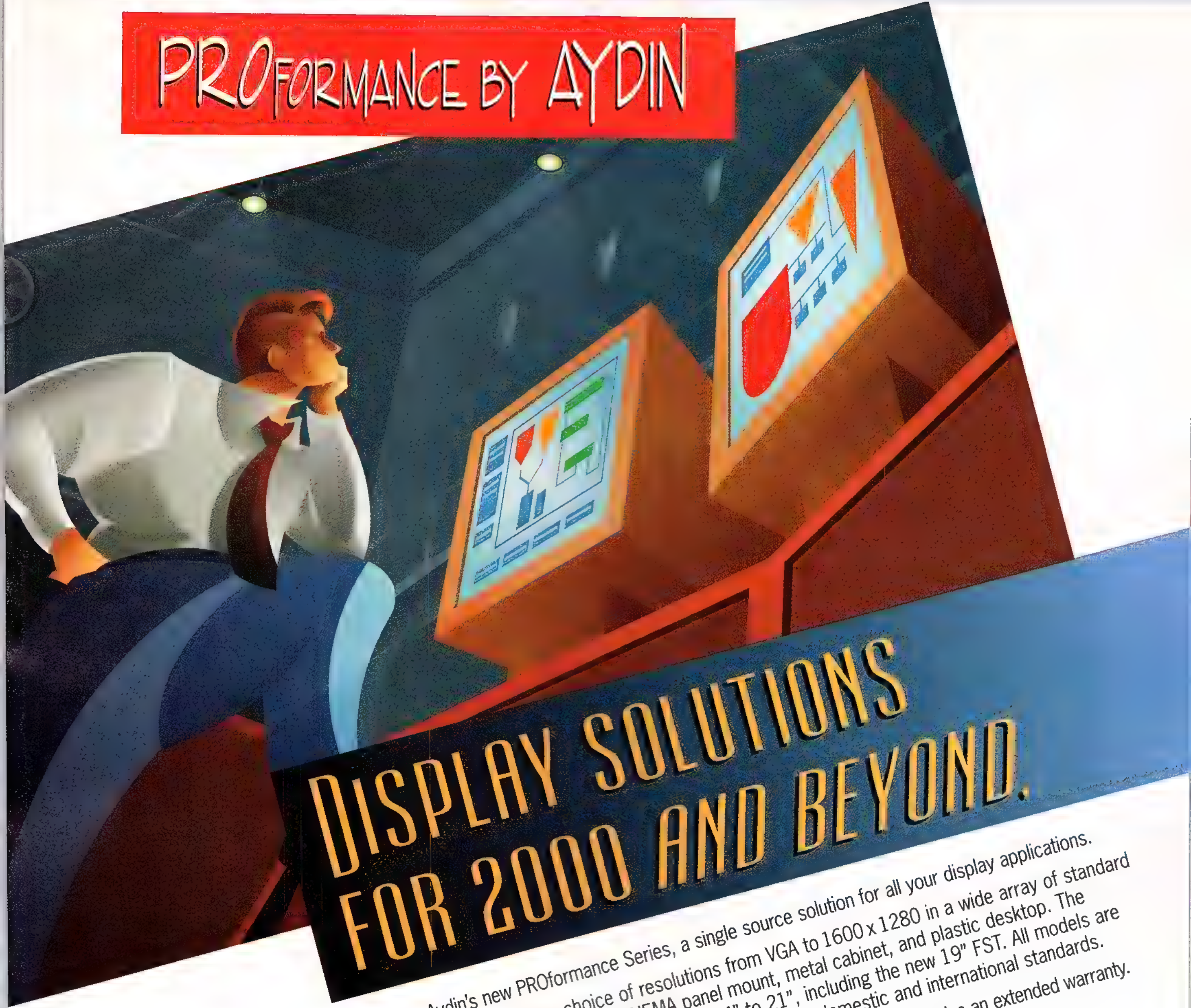

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Circle 841

Simulation helps create manufacturing processes

More than ever before, design engineers must work concurrently with manufacturing teams. Simulation offers a more efficient way to make that happen

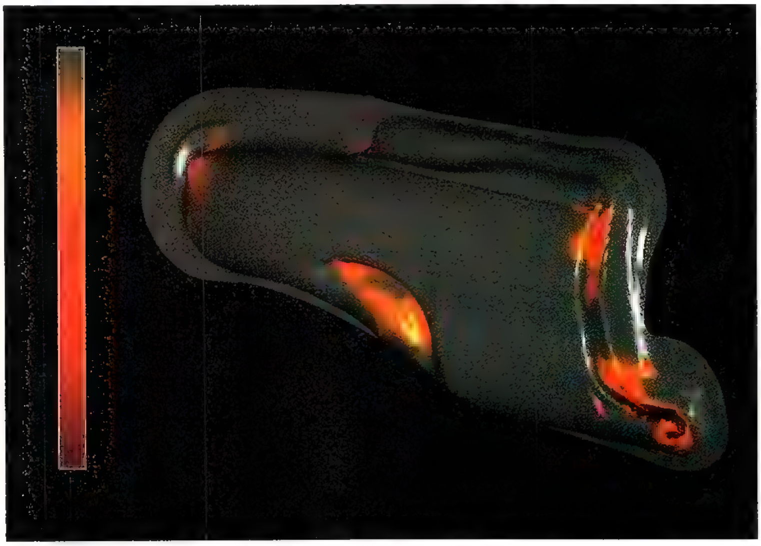
Charles J. Murray, Senior Editor, *Design News*

When engineers from Lamb Technicon (Warren, MI) propose a new manufacturing system to a potential customer, they no longer need to spend weeks building prototype parts to prove their concept. Instead, they create a step-by-step manufacturing process in days. They lay out each operation, from milling and drilling to tapping and reaming. They specify machine tool speeds and feed rates. They produce software code for use in production. And they save money in the process.

How? Simulation. Lamb Technicon, like many of today's major manufacturing enterprises, uses high-powered software to create the process and the prototype part on screen. "Using a 'soft' process instead of an actual validated process, we can shorten our validation time from a couple of weeks to a couple of days," notes Ken Rommelaere, director of CAD for Lamb Machining Systems (Warren, MI). "It changes the time by a factor of about ten to one." Lamb Technicon, a machine tool builder and systems provider, still makes physical prototypes for customers who want them. Increasingly, however, the company and its customers are reaping the benefits of a digital approach to process validation.

And they're not alone. All of the Big Three automakers and many other firms now use software programs to simulate stamping, forging, casting, and molding, as well as various machining processes. As a result, they're cutting months from their product development times. Automakers, for example, now build cars in as little as 24 months—down from 60 months a decade ago. And much of that time reduction can be traced to the use of process simulation.

At the same time, simulation holds the key to dramatic cost reductions. By simulating processes on screen, manufacturers say they can now leapfrog over so-called soft tooling and move straight into production. What's more, they can eliminate scores of costly engineering changes.

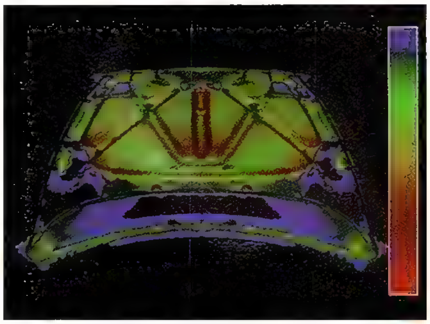


A rear-quarter panel from Chrysler: Using stamping simulation software, engineers can check for stresses and strains in the part. (Figure courtesy Chrysler)

Equally important, engineers can implement dramatic improvements in the quality of their products. Simulation enables them to pick out surface anomalies—such as wrinkles or tears—before they happen. As a result, fit and finish of parts is better than ever. "With computer simulation, you can explore your entire design space," says Greg Clifford, director of compute intensive applications for Silicon Graphics/Cray Research (Eagan, MN). "It allows you to optimize. You can get right in the middle of your manufacturing window, so you're never close to using a process that won't work."

SIMPLIFYING STAMPING

The rapid spread of manufacturing simulation systems, however, is a relatively recent phenomena. Up until a few years ago, such programs gobbled up huge amounts of computer memory, and demanded more speed than most computers could deliver. As a result, the only systems that could run the software in reasonable time frames were supercomputers, which typically started at costs of about $2 million apiece.



Stamping software helps engineers pick out likely areas of failure. (Figure courtesy Chrysler)

Advances in computer hardware, however, have changed all that. "CPU speeds are much faster today than they were five years ago," notes John Hallquist, president of Livermore Software Technologies Corp. (Livermore, CA). "The processors in the work stations used by most engineers are approaching the speed that supercomputers offered five years ago."

As a result, many manufacturing simulation programs can be run on today's workstations, particularly the more powerful ones. And supercomputer makers, who once produced a line of exclusive machines that were out of the price range of most engineering departments, have dramatically lowered their products' costs. Silicon Graphics' (Mountain View, CA) Origin2000 product line, for example, meets the needs of most manufacturing simulations, using deskside or rack-mounted systems. Entry-level systems starting with one to eight processors can be purchased for about one-fiftieth the cost of the supercomputers used for manufacturing applications five years ago.

The availability of less costly hardware has opened up a host of new sim-

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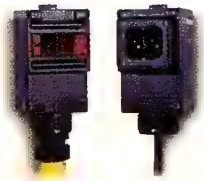

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ulation applications. The fastest-growing of those is stamping. By some estimates, use of stamping simulation programs could save the auto industry alone about $700 million per year in stampings. The reason: Manufacturing enterprises now lose countless dollars when they re-work stamping dies in order to optimize flow of metal.

Though it seems to be a straightforward and simple operation, stamping has been the focus of more than 50 years of study. Seemingly minor mistakes can ruin the yield of a stamping operation, resulting in costly re-working of dies.

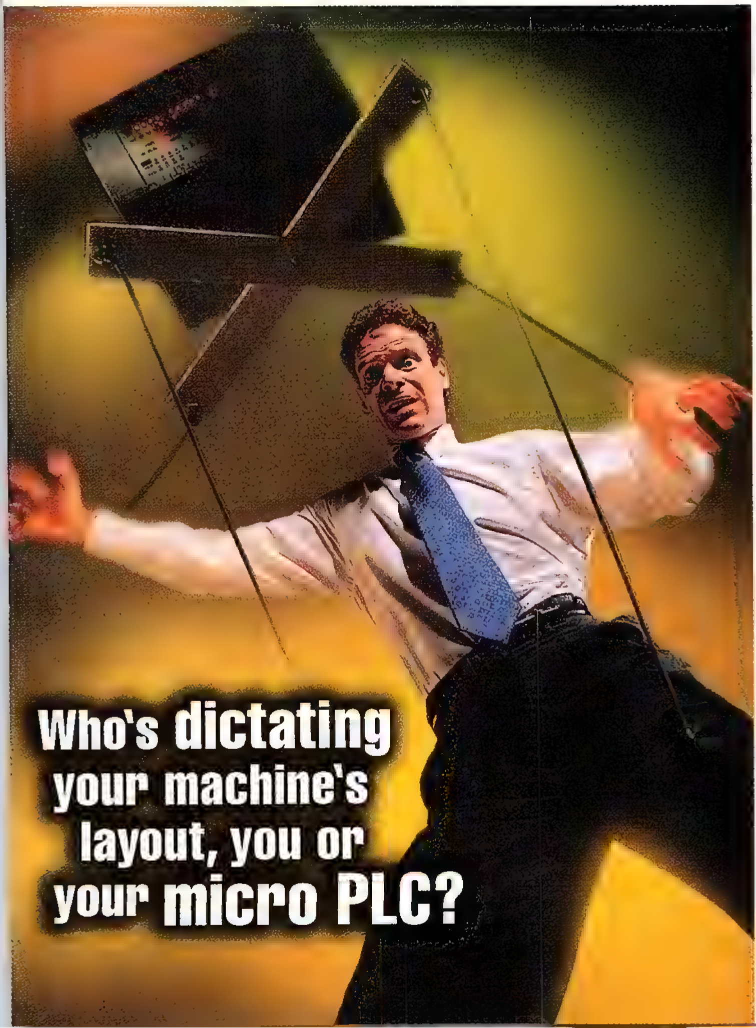
For that reason, simulation offers tremendous potential. Will the part crack? Will it wrinkle? Is there sufficient metal flow? Are certain areas overstressed? Should you increase lubricants? Should you increase the curvature of the tooling? Or should you increase the curvature of the die?

All of those questions, and many more, can be answered on screen. That's extremely important, because it means that the manufacturer doesn't need to try out, then re-machine, physical versions of its dies—a difficult and costly process that steals weeks from the product development effort.

For that reason, automakers around the world have adopted the stamping simulation process. They typically use it on outer panels, inner panels, fenders, doors, hoods, and trunks. More recently, however, they've begun applying it to other stamped metal parts, such as suspension components.

Several stamping simulation programs are available commercially. One of the best-known of those is Livermore Software's LS-DYNA, a general purpose program that initially made its mark in stress analysis applications. A version of LS-DYNA software that was specifically designed for sheet metal forming is called eta/DYNAFORM, made by Engineering Technology Associates (ETA; Madison Heights, MI). Similarly, the French-based ESI Corp. (Troy, MI) makes a program called Pam-Stamp, also designed for use in stamping applications. Dynamic Software (Troy, MI) also makes a stamping simulation software package called Optris.

Silicon Graphics Origin2000: The cost of high-performance machines has dropped dramatically, giving engineers a more cost effective platform for running simulation programs.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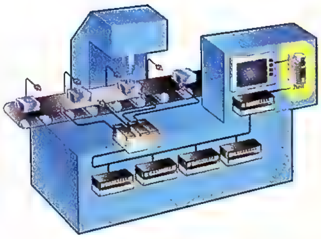

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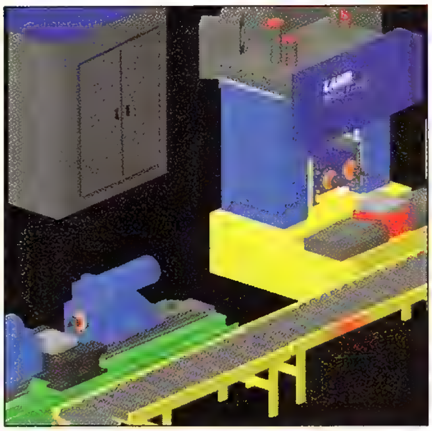
DEVELOPMENT ADVANTAGES

For the designer, the advantages of such software are numerous. The most obvious benefit is the ability to see the part as it's being formed. "When people use the software, they look for the same things they would look for on the factory floor—wrinkles and holes in the metal," notes Bradley Maker, software engineer for Livermore Software. "But the software also allows them to do things they can't do on the factory floor. They can remove the tooling and they can watch the part as it's being formed. They can run the forming process in slow motion. They can see stresses and strains on the part. And they can check the part's thickness at any given point in the process. It gives them far more information than they would normally get."

Having such information up front adds new meaning to the term "concurrent engineering." As a result of it, engineers know whether the component they've designed is manufacturable. If not, they can change the design long before it ever reaches the hard tooling phase.



Virtual NC helps Lamb engineers visualize and evaluate manufacturing operations and their sequencing.

Engineers say that software visualization also provides them with a more effective "post-mortem" of the manufactured part. Unlike physical techniques, simulation lets them pinpoint the source of problems. "If you end up with a torn part on the factory floor, you can't see how or when that tear occurred," Clifford says. "But with computer simulation, you can take the tool away and observe the sheet metal all by itself on the computer screen. You can see how the metal flows through the mold. So you can easily find out how, when, and why the problem occurred." In most cases, Clifford says, engineers can have that information at their fingertips merely by letting the simulation program run overnight.

SOLVING SPRINGBACK

Equally important, simulation programs can now help design engineers deal with so-called "springback" phenomenon. In springback, residual stresses change the shape of a part after it is pulled from the die. As a result, attachment points sometimes don't fit and assembly holes don't line up. "On the assembly line, workers putting panels on the cars have to press on them before the holes will line up," Maker says. "The misfit might only be a millimeter. But when manufacturers go to tighter tolerances, springback becomes an issue."

Engineers can combat the problem by running the simulated stamping, then digitally pulling the part from the die and observing its springback. When the digital dies no longer press against the part, it is allowed to elastically spring back, just as it would in real life. Engineers say that studying springback in this way is not only more accurate, it's simpler. In real life, they say, technicians must attach contact interfaces to the part, to tell where springback occurs. To study the part, they must deactivate the contact interfaces and retract the stamping press's hydraulic cylinder. "On the computer, we take the dies away, and the part can go wherever it wants," Maker says.

Ultimately, engineers say they hope to be able to predict springback, and then integrate those predictions into the initial designs of the products. "We don't necessarily want to know the shape of the metal after it springs back," says Clifford of SGI/Cray. "The real question is: What shape should

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the tool be such that after the part springs back, we've achieved the desired shape?"

COST BENEFITS

Manufacturers report that they also use simulation software to help design a binder for the stamping operation. Binders, ring-like devices that fit around the perimeter of the stamping dies, are necessary to control metal flow during stamping.

Up to now, however, binders have been notoriously difficult to design. "In many factories, someone makes an educated guess as to what the binder should look like," says Hallquist of Livermore Software. "If the part doesn't look right, they add tongue-in-groove features to the binder in hopes that they won't have to cut a new piece of tooling."

Using stamping simulation programs doesn't so much change that process as much as it speeds it up. Engineers still deal with metal flow problems by adding grooves to the surface of the binder, but they do it in software. As a result, they deal with wrinkling or tearing problems without having to send the binders out for re-machining. In the process, they save significant time and cost. "Successful die design involves both the dies and the binders," Hallquist says. "Manufacturers can use software to simulate the whole forming process, and then change the binders, as well as the dies."

Experts say that the ability to simulate the stamping process in such ways yields four key advantages for product development teams. Those are:

1. Simplification of the try-out phase: By designing the process in software, engineers minimize the traditional steps in the try-out phase. They see how the metal flows and how much machining will be required. They look for wrinkles and holes. And they do all of this without having to absorb the tremendous labor and material costs that go with hardware changes during this phase.

2. Elimination of soft tooling: Traditionally, manufacturers work with prototype shops to create so-called "soft tooling" for the prototype phase of product development. Soft tooling, which is typically used for small production runs (100-1,000 pieces), is costly and time-consuming. By simulating the stamping process first, manufacturers eliminate the soft tooling phase, thus saving time and money.

3. Minimizing engineering changes: They rob product development teams of valuable time. Sending a mold or die back for additional machining can take six to eight weeks. Using simulation first, however, eliminates many of those engineering changes.

4. Saving on material costs: Checking for part stresses and strains on screen enables designers to shave fractions of an inch off the thickness of a part. On production runs of a half million or more, those fractions can yield substantial material savings.

For those reasons, experts say that stamping simulation more than pays for itself, particularly when used in conjunction with high production volumes. "Stamping simulation is easily justified," notes Mike Sheh, director of automotive high-performance computing for SGI/Cray. "You get a quick payback on the resources you invest because you clock the savings every day."

INJECTION MOLDING AID

Stamping, however, isn't the only process that can be accurately simulated through software. Casting, forging, hydroforming, stretchforming, tube bending, plastic injection molding and other manufacturing processes can also be simulated.

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VENDOR-SUPPLIED CASE HISTORY

Gearing benefits machine operation

Harmonic drive gearing from HD Systems has found widespread acceptance in machine tool applications such as machining centers; grinding, spark-erosion, and gearcutting machines; as well as laser machining centers. These applications require the benefits of harmonic-drive gearing such as zero backlash, high positional accuracy, high torque capacity, and gear ratios ranging from 50:1 to 160:1 in a single, compact stage.

Machining centers use harmonic drive gearing for tool-changing mechanisms and applications involving table-indexing mechanisms. The high positional accuracy of harmonic-drive gearing allows the workpiece to be located precisely under the machining head. For applications involving high cutting forces, the table is clamped in place after it has been positioned. Cutting forces can be transmitted through the gearing mechanism in applications involving the machining of light metals. An "S" tooth profile doubles the torsional stiffness of its harmonic-drive gearing, as compared to traditional harmonic-drive gearing. This reduces the angular deflection when the drive is subjected to cutting forces.

Grinding machines use harmonic-drive gearing to position inspection probes, and have replaced bevel and worm gears for positioning the table under the grinding disc. Grinding machines for light metals and glass also use this gearing technology for the tilt axes. In addition to the increased torsional stiffness of "S" tooth harmonic-drive gearing, the life and maximum torque capacity have been doubled. This provides higher performance and accommodates shock loads.

Harmonic-drive gearing is also useful for spark-erosion machines where the tool must be moved very slowly and with high accuracy. Hollow-shaft harmonic-drive gearing products also allow fluid and air hoses, shafts, and other components to be passed through the center of the gear. This reduces machine complexity and size. **Circle 840**

Of those, plastic injection molding simulation has been applied most often, mainly because the production volume often justifies it. By some estimates, manufacturers spend more than $20 million per year to de-bug injection molds. They build the molds, rework them, and in some cases, scrap them. "If you think it's expensive to take your car to a mechanic, try taking a 4 x 4 x 4-foot mold of solid tool to a moldmaker and tell him that you've made a fundamental mistake in making it," says one manufacturing engineer. "That's when the money really flows from your budget."

Using a molding simulation software, however, enables engineers to identify flow inconsistencies that cause voids and stress concentrations in the steel. Injection molding simulation software typically incorporates computational fluid dynamics, heat transfer technology, and structural analysis in a single package. One such package, known as Moldflow, made by Moldflow Pty. Ltd. (Kilsyth, Australia) helps solve particularly complex injection-molding problems that would otherwise have no easy solution. It also gives engineers the freedom to experiment with different types of plastics or part configurations.

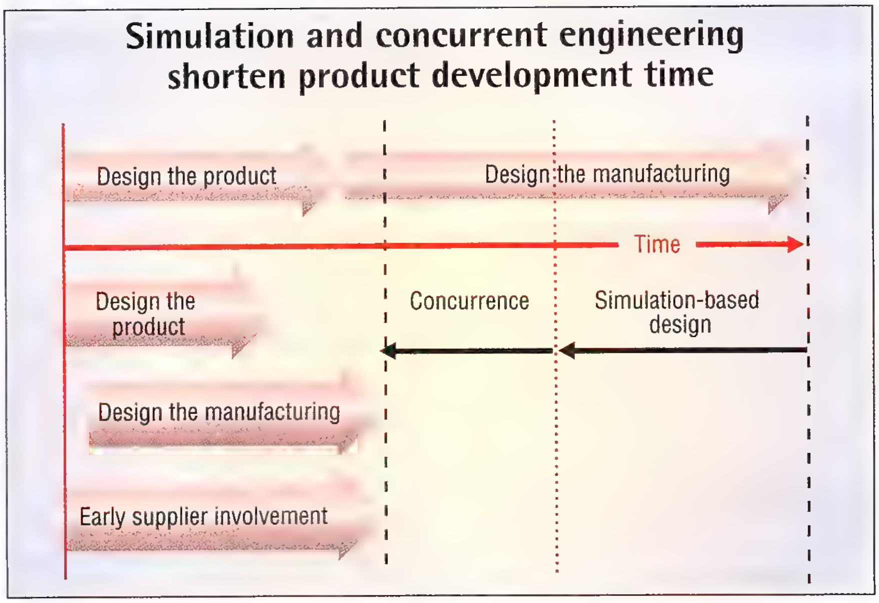
In one case, engineers from Kia Kia Motors Corp. (Seoul, Korea) employed Moldflow in the development of a plastic engine intake manifold. Because the manifold consisted of many curved parts, Kia couldn't use traditional steel molding methods. Instead, engineers settled on lost-core molding. In that technique, a component is submerged in a water bath and the core dissolves, leaving the final part.

Unfortunately, the technique yielded unexplainable problems in the parts, which was why Kia engineers turned to Moldflow. The software enabled engineers to identify flow inconsistencies that caused voids and stress concentrations. It also enabled them to solve problems much faster than they could have using empirical techniques.

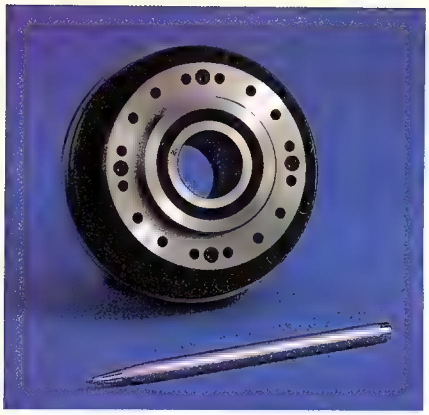
For many engineers, the best aspect of this new breed of software packages is their newfound accessibility. A few years ago, Moldflow and other such programs required supercomputers because workstations lacked the speed to run the software in a reasonable amount of time. But today's computer hardware has dropped so dramatically in price that it puts such software tools within easy reach. "For the money you would spend on one metal stamping tool, you could buy a 32-processor machine to run these programs," Clifford says.

MACHINING MODELS

Simulation packages also extend beyond the forming processes. Some product development teams, for example, are beginning to work with simula-


Simulation and concurrent engineering shorten product development time

Using traditional methods, engineers design the product, then begin designing the manufacturing process. Simulation-based design techniques make it easier for engineers to concurrently design product and process.



New, Hollow Shaft Gearing SHF Series

Featuring a through-bore up to 70 mm in diameter, the SHF Series component sets and gearheads enable the design engineer to pass shafting, wire bundles, or other components directly through the center of the gear. The new SHF Series provides high accuracy in a compact design. This unit design is both axially shorter and lower in weight, as compared to conventional harmonic drive gearing. This is accomplished by using HD Systems patented "S" tooth profile. Rated torques up to 6590 in-lb and positional accuracy better than 2 arc-min can be achieved. Gear reduction ratios of 50:1 through 160:1 are available in a single stage.

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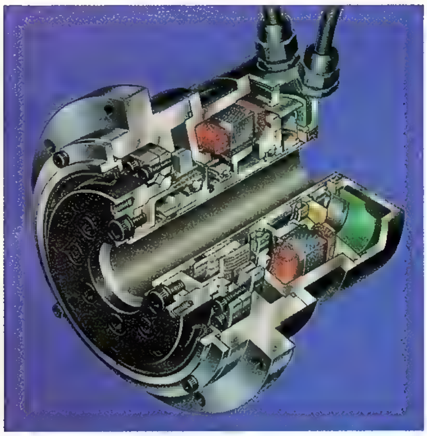

Hollow Shaft DC Brushless Actuators

The FHA Series of actuators feature a through-bore up to 45 mm in diameter and provide high torque and exceptional positioning accuracy. This performance is achieved in a compact design using a patented "S" tooth harmonic drive gear coupled to a DC brushless pancake motor with integral electronic commutation and a high resolution encoder. Rated torques up to 1730 in-lb and positional accuracy better than 1 arc-minute can be achieved. The FHA Series is available in five frame sizes, ranging from 128 to 300 mm in diameter, and 116 to 248 mm in length.

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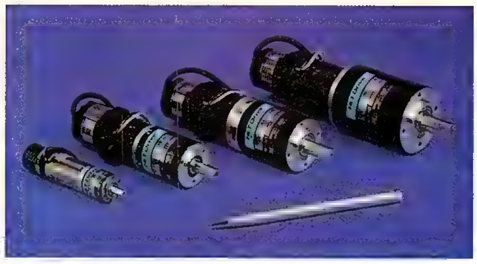
Miniature DC Servo Actuators Mini RH Series



HD Systems offers a line of miniature DC servo actuators for use in applications such as robotics, instrumentation, and factory automation where precise motion control is required. The actuators combine zero backlash harmonic drive gearing with rare-earth magnet DC servo motors to provide both high torque and positional accuracy better than 2 arc-minutes. Rated torques of 2.6 thru 56 in-lb and rated speed of 15 thru 60 rpm are available depending on frame size and gear ratio. The smallest actuator measures just 20 mm in diameter. Encoders and/or tachometers are available as an integral part of the actuator.

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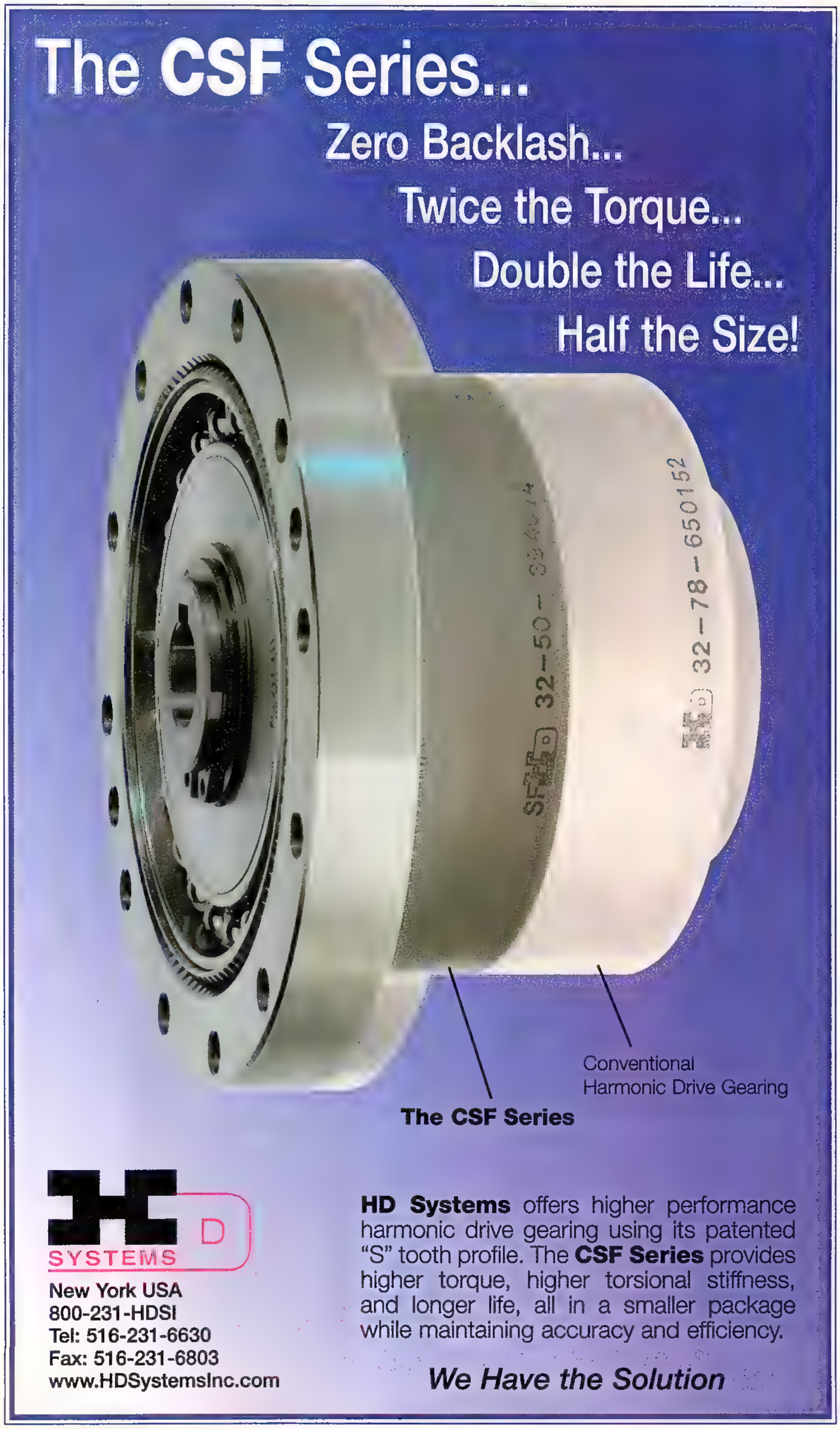

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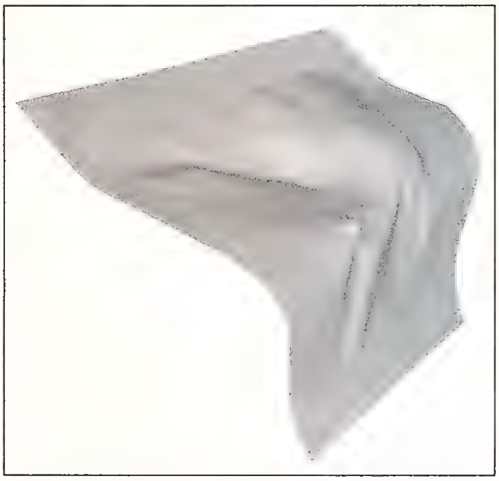
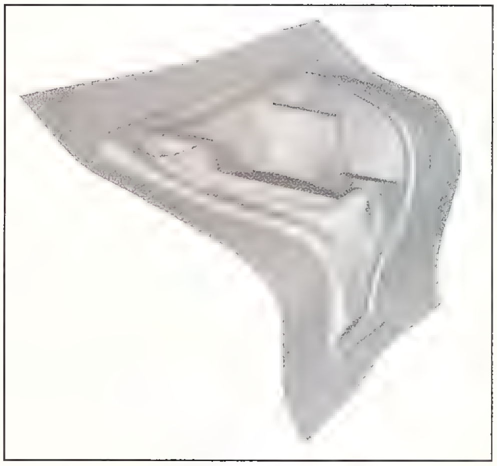
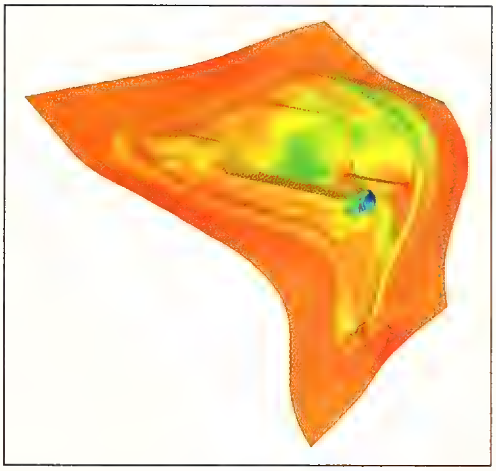


Pulling the dies away enables engineers to see how the part is forming at 70% die closure.



After 100% die closure, simulation shows wrinkles have developed in corners.



After forming, simulation displays part thicknesses. (Gold portions are 0.9 mm thick; blue are 0.007 mm thick, indicating an imminent split.)

tion packages that handle machining operations, such as milling, drilling, piercing, nibbling, and reaming.

Such packages have enabled Lamb Technicon engineers to visualize and evaluate various powertrain machining systems for auto industry customers. Lamb employs two software packages designed by Deneb Robotics Inc. (Auburn Hills, MI). The first, Virtual NC, is a dynamics-based package for visualizing the operation of machine tools and their controllers. The other, known as QUEST, is a discrete event-simulation package that uses CAD to simulate multi-machine systems.

Lamb engineers say that simulation modeling enables them to electronically validate a system for engine manufacturing before the building process has even begun. That's necessary, they say, at a time when engine manufacturers are building products with tolerances measured in microns. "Consider the difficulty of building manufacturing systems, especially flexible manufacturing systems, that can produce parts to micron tolerances," notes Mark Tomlinson, vice president of engineering for Lamb. "You may have to run multiple parts through a series of CNC machines in sequence or in parallel. The statistical probability of producing a non-conforming part is enormous. There is a need to control so many parameters and so many different streams of variability of the end product. Yet, our goal with every system we build is to get ever closer to the elimination of process variances."

Using a simulation system, manufacturers such as Lamb can import their customer's three-dimensional model data. With that in hand, the system checks for features–holes, surfaces, chambers–and suggests tools to do the machining. Finally, it sets up a sequence of operations for the manufacturer.

"It's extremely important for us to be able to validate the processes without prototyping the part," explains Ken Rommelaere of Lamb. "Early on, we can go to our customer and say, "'If you change this operation you may be able to save some cost here.'"

CULTURE SHOCK

Increasingly, such simulations are expected to become a staple, not only for manufacturing engineers, but for designers, as well. As part of an integrated product development team, designers will need manufacturing simulation to enhance fit and finish. They will also need it to cut costs and slash product cycle times.

Of those advantages, most experts believe that the critical one may be product development time. In the auto industry, for example, lead times on dies typically run more than 80 weeks. If such lead times continue, automakers will never reach their goal of 18-month development times. But simulation offers hope for reducing those lead times.

The key is for design engineers to work concurrently with manufacturing, thus minimizing design changes. "Historically, industry has relied on the craftsman down in the tool room to say: 'Here's how we should build the tool,'" Clifford says. "But it can be extremely costly to go through that kind of trial-and-error process. Simulation offers an alternative to that."

For most, such changes represent a form of culture shock. But with the dramatic increases in computer performance in the past five years, and with many engineers now having access to machines with 32 or 64 processors, it's no longer a shock to the budget. "These days, engineers shouldn't have to worry about finding a more efficient computer," Clifford says. "They should worry about having their computer make them more efficient."

For more information

Pam-Stamp software from ESI	**Circle 773**
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Moldflow software from Moldflow Corp.	**Circle 775**
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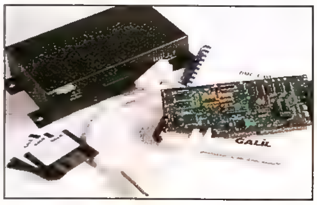

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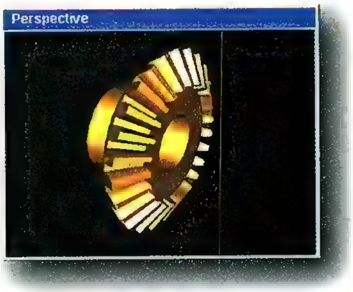

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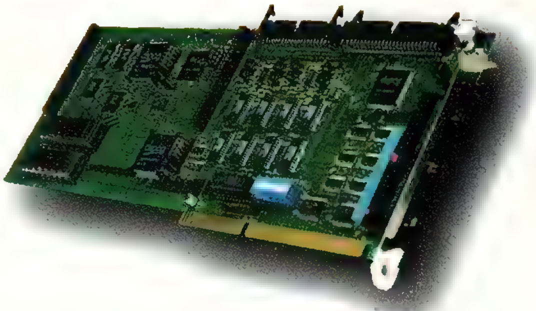

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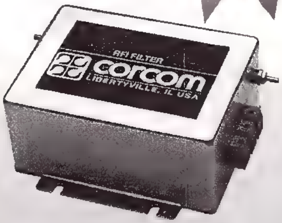

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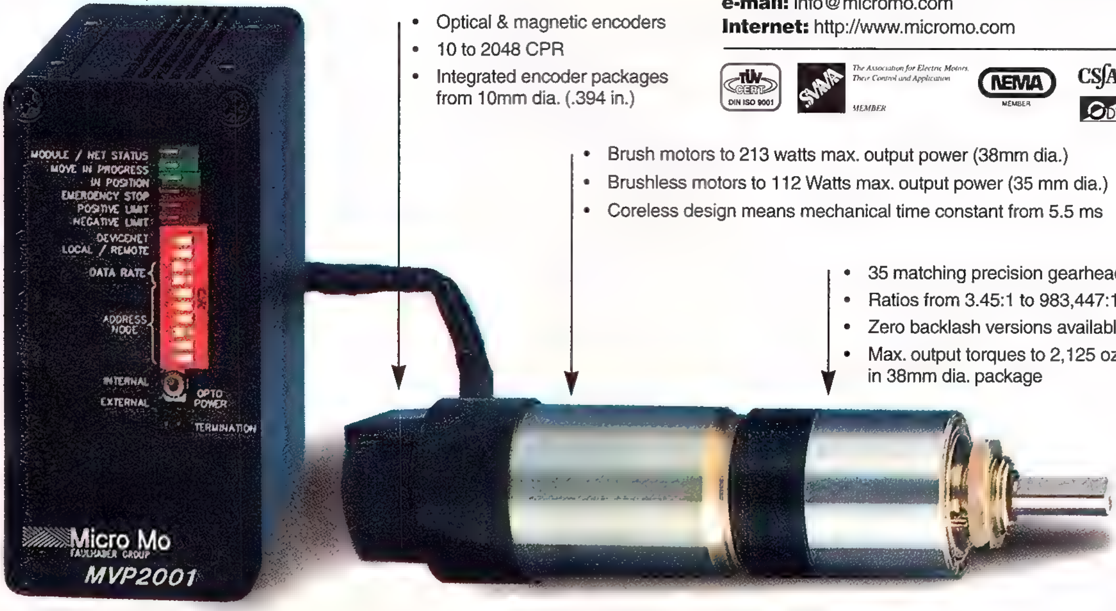

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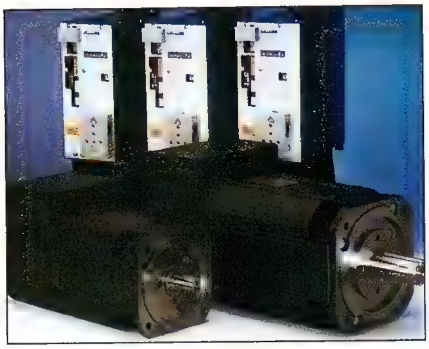
Circle 811



MOTORS

GOLDLINE™ V Series motors feature the VECTOR**STAR** amplifier and provide smooth operation up to 12,000 rpm. Rapid acceleration capabilities provide more accurate control of machine-tool spindles. Motors are available with continuous output ranges from 3 to 50 kW. The VECTOR**STAR** amplifier is rated from 8 to 90 kW continuous output and features flux vector control, 32-bit feedback, and a modular or integral power supply.

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Radford, VA 24141
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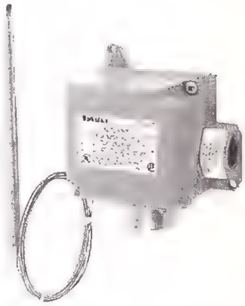

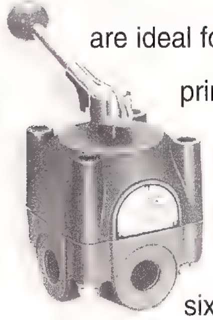

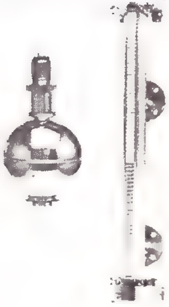

BALL BEARING

Angular-contact ball bearing can achieve a maximum dn speed of 2.1 million. The bearing features ceramic balls, steel bearing races, and 25-degree contact angle. Using a smaller ball made of a lighter-weight ceramic material results in reduced operating temperatures. The lower temperature rise minimizes shaft distortion, and the smaller temperature differential minimizes the reduction in clearance.

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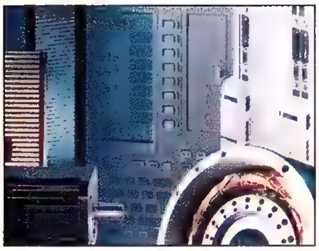

CONTROL-SYSTEM MODULES

MTC200 high-performance, PC-based, open-architecture control modules feature software that allows the user to mix-and-match specific hardware modules needed for varying metalcutting applications. Standard hardware modules are available for CNC, PLC, HMI, and I/O functions. The modules use open industry standards for CNC and PLC programming, and for communication between all modules. MTC200 modules are for stand-alone milling, turning, grinding, and automation applications, as well as complex, high-production machine tools.

Mannesmann Rexroth Corp.
Indramat Div.
5150 Prairie Stone Pkwy.
Hoffman Estates, IL 60192
FAX (847) 645-6201
Circle 881

SERVOMOTOR

Brushless dc servomotor is compatible with industry-standard servoamplifiers and servo controllers. Standard NEMA packaging in sizes 23 and 34 permits drop-in replacement of motors into existing stepping-motor-based systems, without changing mechanical hardware. The motors operate at speeds up to 15,000 rpm and are for applications involving high-precision processing in high-tech, medical, industrial, and material-handling industries.

Eastern Air Devices Inc.
1 Progress Dr.
Dover, NH 03820
FAX (603) 742-9080
Circle 882

SWITCH

MultiPro™ and 2000 Series automation controllers have a programmable limit-switch capability (PLS) that allows state synchronization of digital outputs based upon a servo-axis position. Two banks of 8 digital outputs can be controlled by a single axis, or two independent axes. Controllers are for use in machine-control applications such as packaging operations that perform high-speed gluing.

Control Technology Corp.
25 South St.
Hopkinton, MA 01748
Circle 883

CNC KITS

CNC kits are used to develop PC-based CNC controllers for automating machine tools. Multi-axis motion control cards enable six axes of servo and stepper control on one card. The software provides a basic set of EIA-274 defined G-codes, the ability to define work coordinates and tool-length offsets, and 99 user-defined miscellaneous functions for tool changes. The motion-control card included in the kits supports linear and circular interpolation, continuous path contouring, master/slaving, cam profiling, and registration.

Precision MicroControl Corp.
2075-N Corte del Nogal
Carlsbad, CA 92009
FAX (760) 930-0222
Circle 897

ACTUATORS

FHA Series brushless actuators provide a hollow shaft up to 45 mm in diameter, targeting them for use in robotics, machine tool, and other applications where cabling, laser light, or shafting pass through the center of the actuator. The actuators use zero-backlash, high-stiffness "S" series harmonic-drive gearing to deliver continuous rated torques up to 1,730 inches-lb and positional accuracy better than 1 arc-minute. Integral brakes are available for applications where position must be held with the power off.

HD Systems Inc.
89 Cabot Ct.
Hauppauge, NY 11788
FAX (516) 231-6803
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ACCELEROMETERS

PITBULL™ Series accelerometers for SMART MACHINERY programs are embeddable inside machinery housings at the outer race of the bearing where sensitivity to the symptoms of impending machinery failure is optimal. The accelerometer is equipped with an integral cable and features low-noise operation, low power consumption, a broad frequency bandwidth, self-test bias indication, high shock survivability, and a wide-operating temperature range.

Oceana Sensor Technologies Inc.
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Virginia Beach, VA 23454
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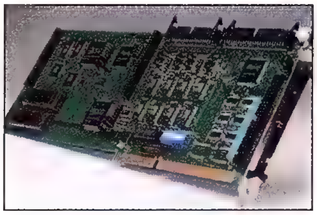

CONTROLLER

Mx4 Octavia parallel processing controller combines the functionalities of a high-speed computer, an industrial PLC, and a motion controller with motor commutation features. The Mx4 is for 1- to 8-axes motion control applications. The controller also directly interfaces with standard CAD/-CAM systems, with no requirement for post processing.

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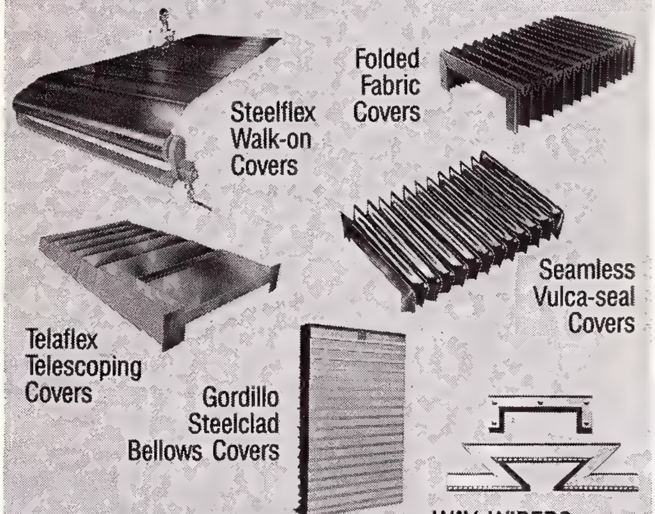

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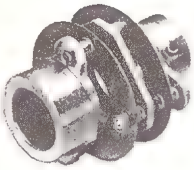

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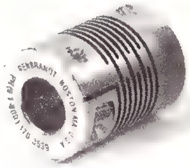

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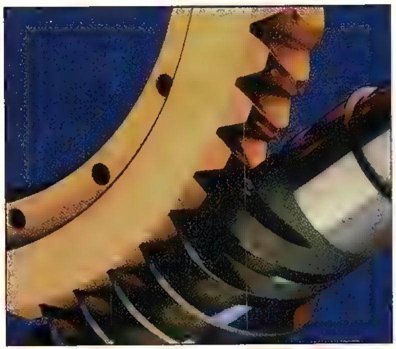

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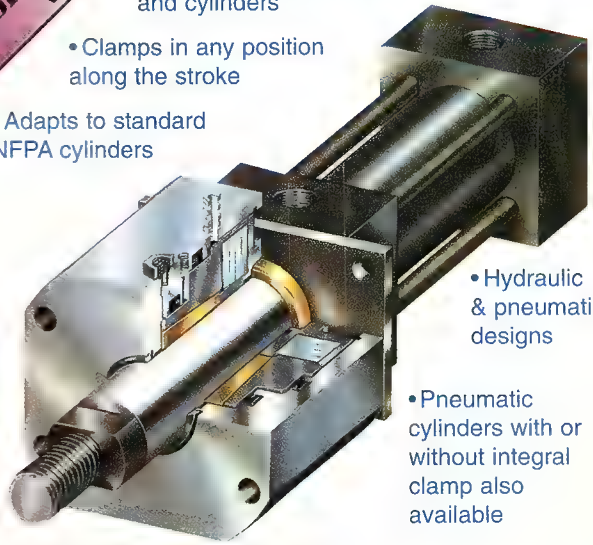

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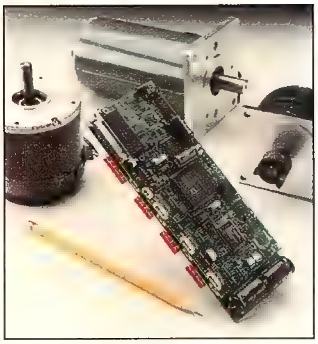

SERVO CONTROLLER

MAX2000™ multi-axis brushless servo and drive module incorporates networks, a motion controller, and motor drives together in one unit. This distributed servo controller can provide a 10:1 reduction in wiring through distributed control; offers a smaller footprint for difficult-to-mount locations; compensates for high inertia mismatch; and has the processing power for three embedded axis.

Agile Systems Inc.
440 Phillip St.
Waterloo, Ontario, Canada
N2L 5R9
FAX (519) 886-2075
Circle 888

CONTROLLER

Model 5950B PC/104-compliant servo motion controller measures 3.55 x 3.775 inches and features a high-precision 16-bit monotonic DAC. This PMD 1401A DSP-based controller provides trapezoidal and S-curve profiling. High-speed clamping diodes provide extended transient protection against external spiking and noise for the I/O. Model 5950 is for tough precision industrial applications in robotics, medical instrumentation, and packaging machinery.

Technology 80 Inc.
658 Mendelssohn Ave. N.
Minneapolis, MN 5542
FAX (612) 542-9785
Circle 889

COUPLINGS

Zero-backlash Flexbeam™ beam-style flexible couplings in stainless-steel and aluminum versions include the Flexbeam-3™ and the Flexbeam-2™. The Flexbeam-3 has two sets of three spiral cuts and is for servo applications, the Flexbeam-2 has two sets of two spiral cuts and is for applications that use delicate components such as encoders and tachometers. Stainless-steel Flexbeam couplings are manufactured from type 17-4 PH material.

Ruland Mfg. Co. Inc.
380 Pleasant St.
Watertown, MA 02172
FAX (617) 924-9205
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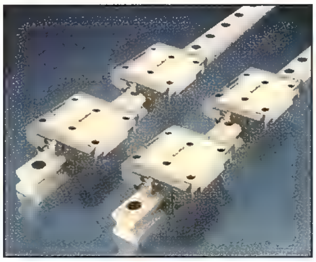

LINEAR ROLLER GUIDES

AccuMax™ linear roller guides feature continuously crowned races, which maintain roller-race orientation at all times, in spite of minor carriage deflection or minor out-of-parallel races caused by application loads. Called the ARCuate Advantage™, this design eliminates edge loading which can cause tapering and skewing. AccuMax linear roller guides have four tracks of recirculating rollers, four accessible lubrication points, and a full-length wiper. The guides are available in 35-, 45-, and 55-mm, with dynamic load capacities of 46,000, 80,000, and 115,700N, respectively.

Thomson Industries Inc.
2 Channel Dr.
Port Washington, NY 11050
FAX (516) 767-4570
Circle 891

GEARHEADS

ServoFit™ precision planetary gearheads feature HeliCamber™ gear technology to reduce backlash, gear noise, and wear. All planet gears are hardened and ground to eliminate any irregularities that may generate pulsations in the drive train, which can lead to speed fluctuations. ServoFit gearheads provide 3 arc/minutes backlash minimum and are available with 1 arc/minute backlash. Applications include robotics, plastic molding, machine tools, factory automation, metal forming, and fabrication.

Stober Drives Inc.
1781 Downing Dr.
Maysville, KY 41056
FAX (606) 759-5045
Circle 892

LINEAR MOTION SYSTEM

SL2 corrosion-resistant linear motion system is a stainless-steel slide system. Aluminum carriage plates are treated with a corrosion-resistant coating certified for food use. The slideaways are hardened and ground for maximum reliability and finished with a chemical passivating process to improve corrosion resistance. The SL2 system is compatible with the Generation II slide system, and is available in slide widths including 12, 25, 35, 44, 50, 60, and 76 mm. Low-friction characteristics allow dry operation.

Bishop-Wisecarver Corp.
Box 1109
Pittsburgh, CA 94565
FAX (925) 439-5931
Circle 893

SERVO AMPLIFIERS

MBL and MBLX Series compact, brushless servo amplifiers are part of the Motion Science™ product line. These MOSFET, pulse-width-modulated (PWM) amplifiers provide four-quadrant control in torque, velocity, and voltage modes. The MBL and MBLX are for use with brushless motors up to 850 oz-inches, and include 16 different board-level and housed models in three voltage and current ranges. Applications include pick-and-place, semiconductor, medical, packaging, inspection, robotics, and factory automaton.

Cleveland Motion Controls Inc.
Servo Controls and Systems Div.
2600 Liberty Ave.
Pittsburgh, PA 15222
FAX (412) 261-8609
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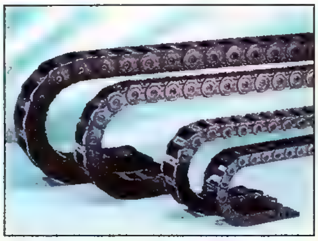

CABLE CARRIERS

Versatrax™ plastic cable carriers are constructed of high-strength, fiber-reinforced nylon. The carriers feature a snap-together/hinge-opening design and a snap-in cavity partitioning system. Versatrax cable carriers are available with either totally enclosed or open inner styles, combined with either enclosed or open outer faces. The series also offers a choice of either plastic or aluminum-profiled shelving systems. The design of each link and double-radius control stops minimize noise, which limits the polygon effect. Double-radius control stops minimize noise. Versatrax carriers are for small-size automotive and printer applications to automation, robotics, machine tools, and oil rings.

KabelSchlepp America Inc.
7100 W. Marcia Rd.
Milwaukee, WI 53223
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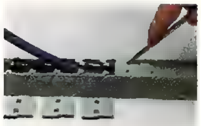
Energy Tube



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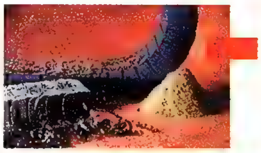

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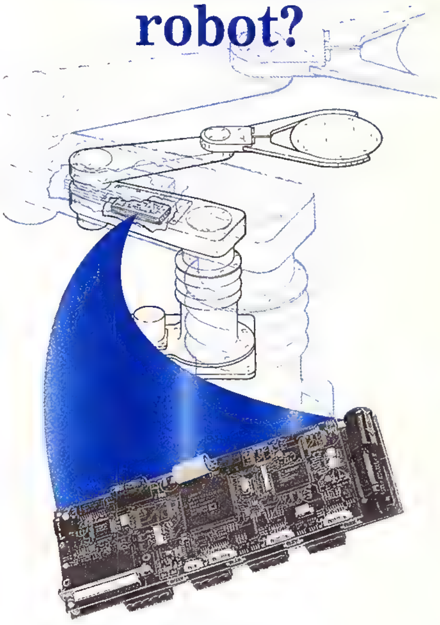

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N2L 5R9
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email: sales@agilesys.com

Circle 832

VENDOR-SUPPLIED COMPANY PROFILE

Packages provide turn-key solutions

Thomson Industries' off-the-shelf motion control packages provide high-performance, industrial quality, turn-key servo axis solutions. A single part number specifies the pre-engineered, pre-matched motor/drive/controller packages, which can be used in either single- or multi-axis applications, and include molded cables, set-up software, and documentation. These packages are for applications where high performance, durability, and harsh environmental protection are required, such as XYZ systems, general automation, pick and place, web synchronization, and metalworking.

BLX Series brushless servomotors. BLX Series brushless servomotors feature high-energy magnets to provide a torque of 5 to 280 lbs-inch, continuous, and—15 to 840 lbs-inch, peak. The motors are constructed with IP65 environmental sealing, military style fluid-tight connectors, oversize bearings, a winding thermal switch, and feature an internal 2000 line bearing-mounted commutating encoder.

Digital servo drives. OMNIDRIVE™ digital servomotor drives incorporate advanced microcontroller technology for fully digital "smart" brushless servo amplifiers with integrated power supplies. The drives simplify integration for new or existing control systems by offering multiple command source configurations including analog input, step and direction, serial link, encoder follower, presets, and electronic gearing.

Stand-alone 4-axes servo controller. TMC-2000 stand-alone controller controls up to 4 axes of servo and/or stepper motors and can run four programs simultaneously. Available with prefabricated cables that interface with Thomson brushless motors and digital amplifiers, the TMC-2000 provides a plug-and-play solution to motion control problems including point-to-point, linear and circular interpolation, electronic gearing, and user defined path.

The controller can be integrated with factory automation systems and allows equipment designers to select either host-computer or stand-alone operation. **Circle 849**

Advertiser Index

Advertiser	Page No.	. . RS No.
A & A Mfg Co.	S•59	835
A & A Mfg Co., Gortec Div.	S•55	842
ABB Flexible Automation Inc.	S•35	826
Advanced Machine Eng. Co.	S•59	848
Aerotech Inc.	S•32	825
Agile Systems	S•61	832
Allied Electronics	S•2	803
Aydin Displays	S•43	831
Barksdale Inc.	S•57	845
Cleveland Gear Co.	S•59	847
Compact Air Products Inc.	S•10	809
Control Technology Corp.	Cov-4	802
Copley Controls Corp.	S•63	857
Corcom Inc.	S•55	843
Custom Servo Motors Inc.	S•44	841
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Gusher Pumps Div., Ruthman Pumps	S•20	816
HD Systems	S•51	840
Heidenhain Corp.	S•22	846
Igus Inc.	S•61	834
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Indramat	S•21	815
Interlink BT LLC	S•5	804
Kabelschlepp America	S•61	833
Kollmorgen Motion Technologies	S•40,41	829,838
Linemaster Switch	S•48	837
Lintech	S•20	817
Micro Mo Electronics	S•55	855
Nimac	S•8	806
Nook Industries	S•37	827
Norton Advanced Ceramics	S•25	818
NSK Corp.	S•56	811
NTN Bearing Corp. of America	S•17	813
Oceana Sensor Tech.	S•38,39	828,854
Omron Electronics Inc.	S•46,47	859-860
Oregon Micro Systems	S•11	810
Precision Micro Dynamics	S•63	856
Renbrandt Inc.	S•59	836
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Tc Service	S•29	822
Technology 80 Inc.	S•27,29,31	821, 823,824
Thomson Industries Inc.	Cov-3	
Trans Tek Inc.	S•42	830
Turck Inc.	Cov-2	800
Vickers Inc.	S•26	819
Yaskawa	S•7	805

VENDOR-SUPPLIED CASE HISTORY

OEMs benefit from Quickstep™ state language

In today's fast-paced manufacturing environment, engineers face an increasing need to customize standard products to meet customer needs. Cost-effective customization can often be the key to product differentiation and success. Oliver Design Inc. of Scotts Valley, CA found substantial benefits in this area by leveraging a new generation of control products.

Oliver Design manufactures disk and wafer cleaning systems. Without question, the magnetic media market faces tremendous market pressure to achieve higher densities and higher transfer rates. Therefore, precision control is paramount to achieve product quality in this manufacturing environment. In designing their disk cleaning systems, Oliver selected Control Technology Corp.'s high-performance model 2600 controller and the Quickstep™ state language. In order to provide maximum flexibility, a modular approach was used in the disk-cleaning system design.

Customers may purchase different combinations of texture, immersion, scrubber, rinse, and spin-dry modules to suit their application requirements. In addition, the modules can be combined in varying orders depending upon end-user requirements. The multitasking 2600 controller provides the capabilities needed to precisely control this system. A variety of I/O and multi-axis motion control modules can be mixed and matched to leverage the Quickstep state language.

Quickstep goes beyond typical ladder logic by providing a more intuitive step framework, reducing the need for extensive training. Since the step framework more closely parallels the operation of the machine, existing flow and logic diagrams can be readily converted to machine control steps. An aggregation of high-level instructions empowers the designer to use the latest machine control capabilities with minimal effort.

The result: Oliver Design's engineers are able to implement control solutions to provide the flexibility and customization their customers need. The controller allows the engineer the flexibility to enhance the product and remain competitive. **Circle 802**

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- DC Servo Amplifiers
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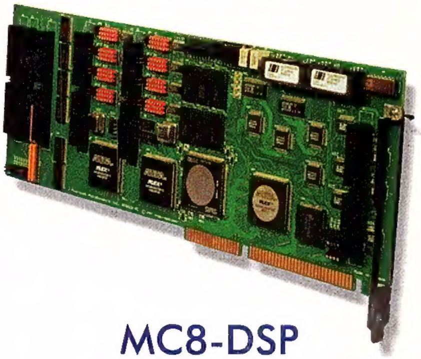

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Recapturing the competitive EDGE

Richard A. Curless
Director of Technology Development
Cincinnati Milacron, Machine Tool Group

As a 30-year veteran of the machine tool industry, Richard Curless has experienced the peaks and valleys of the manufacturing business. He was named chief engineer of Cincinnati Milacron in 1984, and later served as manager of research and development and manager of advanced technology. In his current position as director of technology development, Curless has overseen the company's technical resurgence in the 1990s. A licensed professional engineer, he has a BSME from the University of Cincinnati, an MSME from Oklahoma State University, and an MBA from Xavier University.

Design News: Other than the obvious loss of market, are their any early signs when a company is losing its competitive edge?

Curless: Before you start to lose share of market, you can measure yourself on the frequency of your new products. If you're putting fresh sheet metal and paint on your old machine and giving it a new name, then you should probably start to look over your shoulder. You're a target. That's what happened to us in the 1970s. Our lead times were growing longer. We told our customers to wait. Meanwhile, Japanese manufacturers responded to our customers. They applied their own technology internally, as well as applying it to their own new products.

Q: How does that type of thinking take hold in an organization?

A: The key is the amount of investment that a company is willing to put back in its business. When a business cycle is down, how do you prepare to bring out a new product? You need to introduce your new products when the market is beginning to build up steam. But it's very difficult for businesses to invest money in new products when they are barely breaking even. Their first inclination is to cut back on expenses. It's a tough task, but you have to find ways to start new product development when you are in the down cycle, otherwise you won't be ready when the upswing arrives.

Q: How do you accomplish that?

A: You need to have a core group of people who are very talented and who can make things happen very rapidly. Those are your mainstays. They are the ones who make it possible in a downturn. You have to rely on those people to deliver the goods.

Q: Let's say you invest that capital in new product development. How do you ensure that you'll get a real advance in technology?

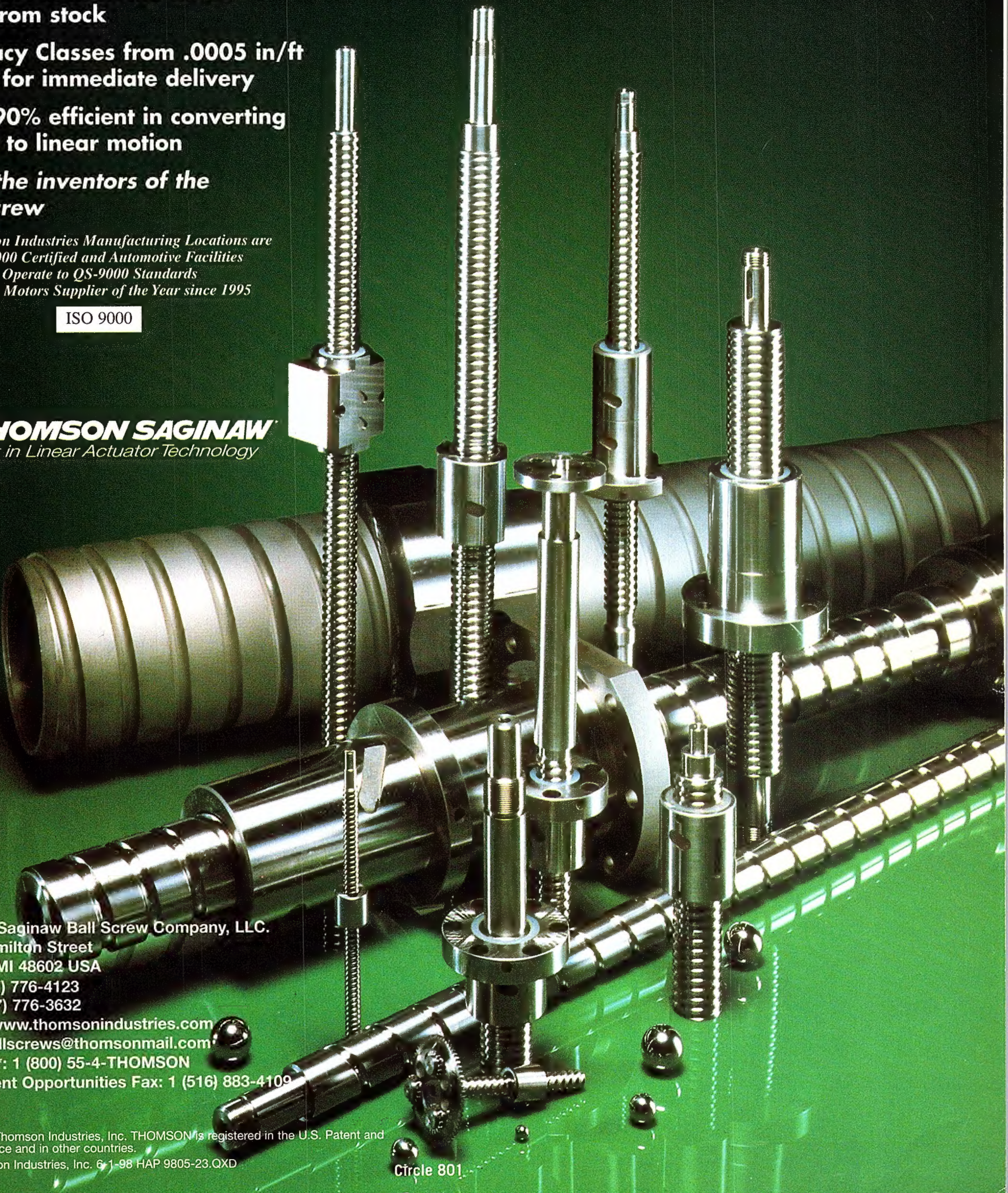
A: I've seen businesses, particularly in machine tools, try to bring out new products when they weren't ready. They didn't do all their homework. They didn't do all the testing. They didn't do all the evaluation that's required. Part of the reason for that is they didn't come up with a complete team. You have to have a complete team. And you have to understand the needs of the customer. You can't take the next step in new product development if you are only willing to make a 5 to 10% incremental change. You've got to make major changes in your overall product.

Q: How do you define a "complete team?"

A: You need key marketing people who can sit down with the engineers and have solid discussions about what the customers like and dislike. You need good participation from your manufacturing engineers, so you can achieve "art to part." By that I mean, you want to put some art into your product that flows directly into your manufacturing environment. You also need purchasing, financial, and accounting people who get the best value for what you are trying to accomplish. And you need a service person who understands maintenance, repairs, setup, and installation issues. Finally, involve some of your key customers. Make them part of your team.

Q: Engineers today are deluged with new corporate program ideas. Given this, how do you convince them that this isn't just another here-today, gone-tomorrow program?

A: It has to start from the top. You can't ask a team to make something happen and then have a few half-hearted meetings. That really isn't fair. The organization has to convey the message: "This product is crucial to the life of our company." And you better come up with some fundamental expectations. If you don't, you may get a better mousetrap, but it might not be what you're seeking. We've been very aggressive in that. We've said we want 40% fewer parts, 40% fewer labor hours, and 40% less floor space. And you owe it to the team to help them achieve that.



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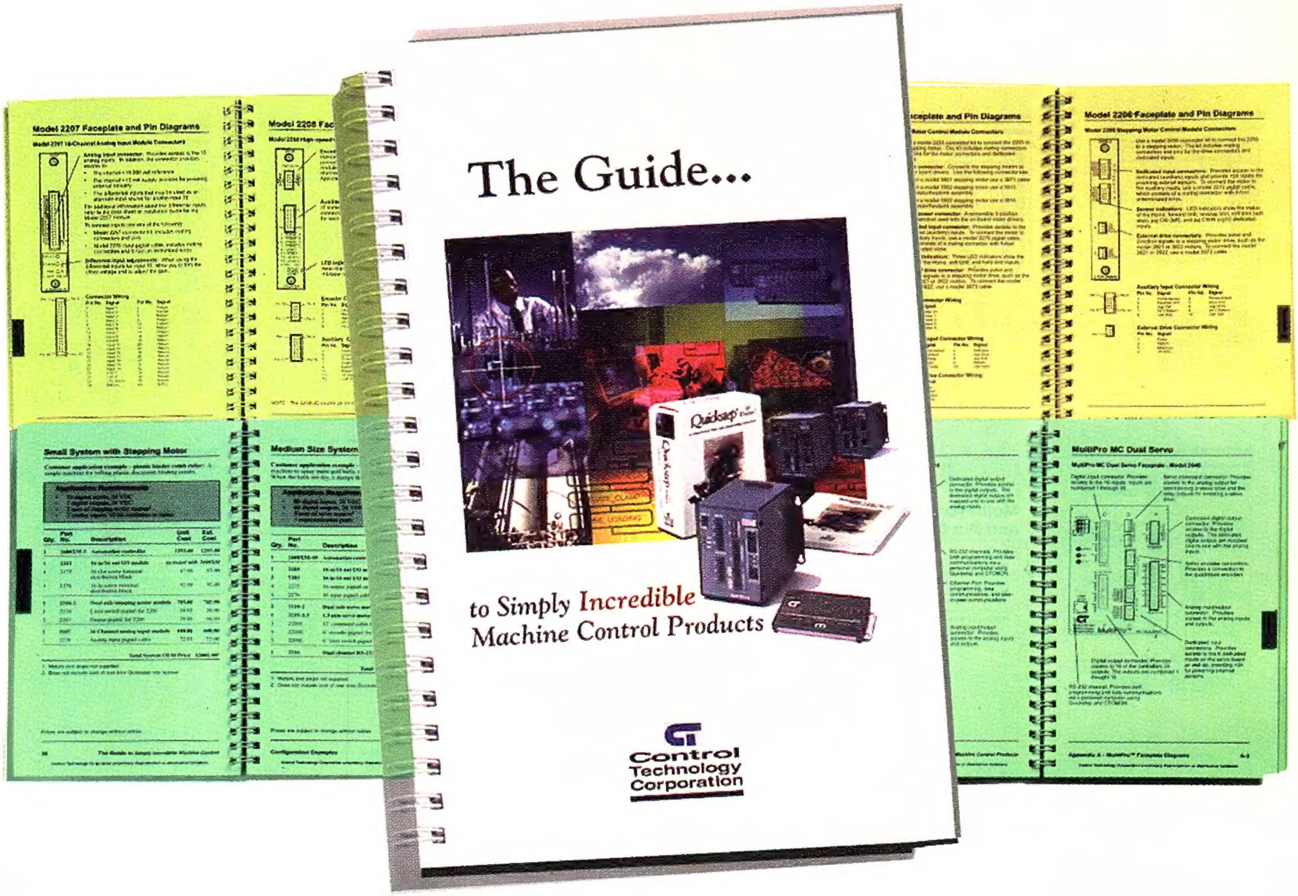

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